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POTATO-CULTURE.

THE MAINTENANCE OF PURE AND VIGOROUS CROPS.

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THE inspection of potato crops in connection with certification has afforded excellent opportunities for instructional work. A grower who may be mildly interested in potato-growing in general finds his interest greatly stimulated when his attention is drawn to the shortcomings of his own particular crop, and has brought home to him the importance of adopting improved methods and the effect these might have upon the returns from his personal efforts.

Certain points are continually raised. Most of them are not new, and have been so repeatedly discussed in this and other journals and between growers that there would be no justification for further discussion were it not that recent research has thrown considerable light upon these several points. In the present article the writer will attempt to reply to some of these questions from his own experience, and in the light of recent investigation undertaken by such workers as Dr. R. N. Salaman in England, Dr. P. Murphy in Ireland, and Mr. T. P. McIntosh of the Board of Agriculture, Scotland.

"Seed" Considerations.

CUT VERSUS WHOLE SEED.

The practice of cutting table tubers for seed purposes is adopted periodically by the more progressive growers, who find in this a means of maintaining the purity and cropping-power of their varieties. It is not suggested that this method should be adopted in the planting of a main crop, for unquestionably the use of whole seed from 1½ oz. to 2 oz. in weight is the most economical for this purpose. The difficulty is that the continual planting of small seed brings in its train two important defects: Firstly, the line may become impure; and, secondly, it is almost certain to degenerate or run out.

Our main red potato, the Dakota, is an extremely important variety, but, as all growers and consumers know, it has become mixed with other reds of an inferior quality. These rogues produce a larger proportion of seed potatoes than does the Dakota, and they multiply more rapidly when seed-size sets are used. Rogueing in the field is not

reliable, as even the most experienced and expert grower cannot pick some of the rogues with any degree of certainty. Since most of them can be detected by their yellow flesh when the table tubers are cut, this practice helps a great deal towards keeping the variety pure.

Arran Chief is perhaps the most important commercial white potato, and in this variety Northern Star (Gamekeeper) is the main rogue (Fig. 1). On light land the Northern Star produces a remarkable number of seed-size tubers, and 1 or 2 per cent. in a variety such as Aucklander will multiply at an incredible rate. A rogue that may pass undetected in a line of seed will be more apparent when table potatoes are handled.

These advantages are generally recognized by growers, but it is perhaps not so commonly recognized that the practice plays a very important part in avoiding one of the most serious conditions which affect commercial potato-growing. This condition, generally referred to as running out, is directly due to the group of diseases known collectively as virus disease. Many a grower whose crop is badly run out will acknowledge that he has harvested a very poor crop of table potatoes but "a very nice line of seed." Such seed will, of course, carry the trouble, and once diseased the stock is apparently permanently and incurably infected. A plant infected with virus disease will produce few, if any, tubers of table size, depending upon the degree of infection; consequently the use of table tubers will avoid in some measure this and other diseases.

The writer recently inspected the crop owned by a grower who is recognized as having a very pure line of a certain variety. The grower was much perturbed by the fact that for some years he had been obtaining successively poorer yields. The reason was very obvious, for the ground after digging was littered with the old unrotted tubers, which is one symptom of virus disease. The previous season he had selected some of his best table tubers and planted these down one row in his main crop. The difference between this row and the rest of his crop was so striking as to afford him most convincing proof of the value of selection. It might be mentioned that the value of the produce from this row for seed purposes would be minimized by the fact that the plants were exposed to infection from the surrounding crop. He was advised to dispose of his entire stock and purchase certified seed, but growers evince a remarkable affection for lines that have been in their hands for a number of years. The writer also inspected two widely separated crops grown from seed originating from this particular line. They were both incapable of producing much more than a crop of seed-size tubers, and were therefore a loss to the grower and a menace to the next grower who, in turn, might purchase this seed. It is obvious that the distribution of such lines should be checked, and the introduction of certification is designed to cope with such cases.

Cutting of table tubers for seed has also another benefit, in that it enables the detection of those diseases of which one symptom is the discoloration of the vascular tissue. This tissue lies about $\frac{1}{4}$ in. below the skin, and wilt disease (Fig. 2) and mattery eye may be detected by cutting a slice off the heel end of a tuber. Indications are that it would pay to deal in this way with every tuber and discard those which show vascular discoloration. Unfortunately, in many cases

FIG. 1. NORTHERN STAR ROGUE (FOREGROUND) GROWING IN A CROP OF ARRAN CHIEF.

This rogue is the most common impurity in Arran Chief crops, and can be detected by its dark smooth leaf, dense foliage, and almost total absence of colouring in the stems, which are also not so angular as those of Arran Chief.

[*Photo by H. Drake.*

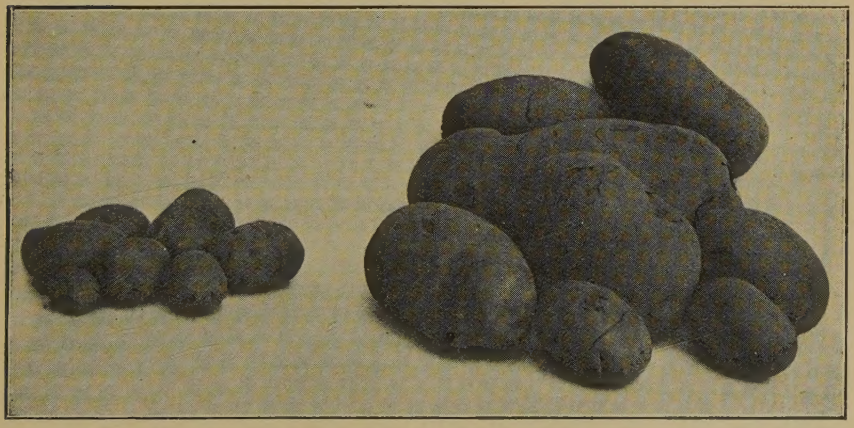

FIG. 2. DEMONSTRATING EFFECT OF WILT-DISEASE ON TWO PLANTS OF SAME VARIETY.

The plants were marked during the growing season—one as healthy and the other as being infected with early wilt. The effect upon yield and size of tubers is quite typical, and a strong argument in favour of selection or of using cut table potatoes for the planting of a seed-production plot.

[*Photo by J. H. Claridge.*

the average man would give up the plan as impracticable, for not infrequently 20 per cent. to 30 per cent. would have to be discarded. Moreover, it is necessary to take the precaution of using two knives and a dish containing a strong solution of formalin. As soon as a knife has been used on a diseased tuber it should be dropped into the dish, and the disinfected knife taken out and used for the next cutting.

This leads one to the conclusion that the cutting of table tubers for seed purposes is a very desirable practice, but owing to the loss from misses it is not one that can be recommended for the main crop. One would, however, unhesitatingly recommend growers to plant each year with cut table tubers a seed-production plot of sufficient size to supply their seed requirements for the main crop. The seed-plot should be isolated as far as possible ; the worst place for it to occupy would be a number of rows running down the centre of the main crop, where it would be liable to infection from both sides.

PREVENTION OF LOSS IN CUTTING.

It is well known that some varieties will not stand cutting. The Aucklander (N.Z. Sutton's Supreme) is a notable example of this. A simple and very effective means of preventing misses is to plant and cover immediately after cutting—that is, before the cut surfaces become dry. The writer had adopted this simple precaution with the Aucklander variety and experienced no loss from misses.

When planting on a large scale this precaution is hardly practicable, and the " wet bag " system adopted in certain parts of Australia might well be tried with advantage in the hot, dry climate of Canterbury. This consists of dropping the cut sets into wet sacks and thus keeping the tubers damp from the time they are cut till the time they are planted and covered.

Drying agents, such as carbonate of lime, gypsum, and superphosphate, may be of some benefit if the sets have to be kept for any length of time, and may assist in the formation of a protective coat over the cut surface. When cut sets have to be kept they should not be bagged up immediately. A sack of freshly cut sets is liable to sweat and heat to an extent sufficient to damage the sprouts. They should not be allowed to dry rapidly, otherwise the protective suberin layer is not properly developed on the cut surface. The ideal is a cool moist atmosphere, and this may be produced by spreading the sets on a floor and covering with damp sacks for a few days.

SIZE OF SEED.

The average size seed used by growers in the South Island is about $1\frac{3}{4}$ oz. ; in the North Island trade a larger size is demanded. From $1\frac{1}{2}$ oz. to 2 oz. is perhaps the most economical for the planting of a commercial crop, although one must bear in mind what has already been mentioned in connection with the continuous use of such seed. Large seed may, in comparison with very small seed, produce a slightly heavier total crop, but this difference is not so marked as is the nature of the resultant crop. The use of large seed will tend to the production of a crop containing a large proportion of seed-size tubers, and, conversely, the use of small seed produces a crop containing proportionately a greater number of table-size tubers.

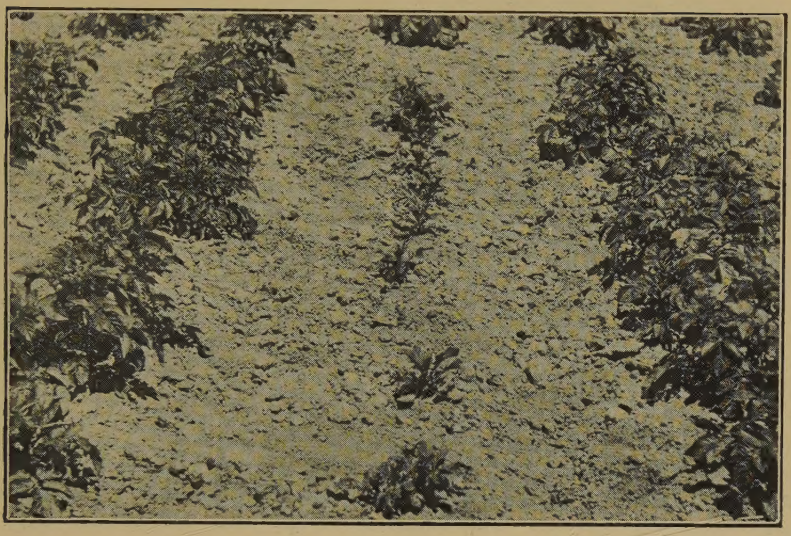

FIG. 3.

FIG. 4.

SINGLE-PLANT SELECTIONS OF AUCKLANDER TALL-TOP (N.Z. SUTTON'S SUPREME) AT EARLY AND LATER STAGES OF GROWTH.

These selections were made from the 1926–27 crop, when the shaws were dead and the tubers ready for digging. At this stage it is impossible to detect virus disease, as is evident from the fact that when these selections were grown in the 1927–28 season one was found to be badly infected. The photos show (above) the early and (below) the late growth of this degenerate selection in comparison with that of the more healthy ones, and demonstrate the advantages of making selections while the crop is still growing.

It is probable that the use of seed of about 1½ oz. to 2 oz. for the planting of a commercial crop will result in the maximum proportion of table size, with the minimum reduction in total yield. Those who are growing entirely for the seed trade might well consider the advisability of planting their uncut table potatoes, which in the ordinary course they could not market as seed. Small sets and large sets, irrespective of the size of the tuber from which they were cut, produce the same result as from large and small seed.

It seems obvious that once a reasonably high standard of health is attained the present practice in connection with seed size is the most economical one to follow.

MATURE VERSUS IMMATURE SEED.

As far back as the year 1880 writers have advocated the use of immature seed, and there are few growers in this country who do not know that this practice is beneficial, however few there may be who practise it. Immature seed is best harvested after flowering and before the shaws are commencing to show signs of ripening. The tubers are still too thin in the skin for marketing in the ordinary way, but if greened the skin becomes tough and the tubers can be handled in sacks without any danger.

The benefit to be derived from the use of immature seed is generally attributed to having by this means avoided infection from virus disease. That is to say, there has not elapsed a sufficient time for the immature tubers to become infected with those diseases carried by the parent plant, although, unfortunately, this does not appear to be the whole explanation of the case. In parts of Scotland and elsewhere virus disease is not much in evidence, and it is reported that in such localities no beneficial results follow the use of immature seed. Dr. Murphy has demonstrated that when virus disease is absent the use of fully mature seed is of distinct advantage.

At present it is not known whether there are any parts of New Zealand comparable to those parts of Scotland and Ireland that to-day produce the bulk of the high-quality seed used for planting the less-fortunate potato-growing areas. The popularity of Southland seed may be explained along these lines, so also may be the practice of sending seed from the South to the North Island. These are matters of very great importance which have not yet been investigated in this country. From the evidence available we can only conclude that the use of immature seed, as adopted by the North Auckland and Pukekohe growers, would be a desirable feature of potato-growing in many parts of New Zealand. If not practicable for the main crop it should be so in connection with the selected tubers used for planting the seed-plots referred to earlier.

GREENING AND SPROUTING.

The value of sprouting seed tubers is generally recognized, but it seems futile to advocate a measure which is, or is said to be, not practicable. On those farms in Canterbury growing potatoes the average area is estimated at about 12 acres*, and it would be difficult

* E. J. Fawcett, this *Journal*, Vol. 33, p. 305.

FIG. 5.

FIG. 6.

SINGLE-PLANT SELECTIONS OF HEALTHY AND VIRUS-INFECTED ARRAN CHIEF AT EARLY AND LATER STAGES OF GROWTH.

During the growing season of 1926–27 some healthy and virus-infected plants were marked. The produce of each plant was kept separate and planted during the 1927–28 season. The photos show the early and later growth during the past season of this one healthy and one virus-infected selection. This demonstrates very clearly the transmission of virus disease from one season to another by means of the seed tubers.

for a grower to find satisfactory accommodation for such a large quantity of seed. It would, however, be practicable to sprout the greened seed to be used in the seed-plot. The use of sprouted seed hastens maturity, and this results in an increased yield in those crops harvested before they are mature. At maturity there may or may not be any increase, hence from the point of view of yield, the practice is of most value in crops grown for the early market.

The sprouting of seed affords an excellent opportunity for culling defective sets. A large proportion of rogues may be identified through variation in the sprouts. Tubers having long weak sprouts should be discarded, as they may be suspected of carrying virus disease, while the condition termed " spindle-sprout " is known to every grower. Tubers with relatively shorter and thicker sprouts produce the strongest plants, and sprouting should be carried out in a cool moist atmosphere where moderate light will induce greening and prevent undue elongation and consequent weakening of the sprouts.

Greening makes the skin tough, and is of particular importance when handling immature seed. If the potato-moth is not active and there is no danger of frost the tubers may be left on the ground for a week or two before being picked up, or they may be spread out in the corner of a grass-paddock. In either case the moisture from the soil prevents undue shrivelling, and the result of this practice is the production of remarkably good seed.

CHANGE OF SEED.

The evidence brought forward by the writer and another in last month's *Journal* clearly proves that a number of growers are in urgent need of a change, and certification affords such growers a guide as to where satisfactory seed may be obtained. This, however, is not quite the point of view to be discussed here.

Growers frequently say that it is time they had a change of seed ; but the result of a change is often disappointing, and one would like to know whether there are any localities in New Zealand particularly suited for seed-production From evidence in other countries one would recommend the introduction of seed from a higher altitude or a colder climate to a lower altitude or warmer climate ; it might be equally accurate to say from a district with a short growing-season to one with a long growing-season. An experiment designed to determine whether there is any advantage in sending seed from Canterbury to be grown in Southland for one or more years has been carried out for one season with negative results. In this case a line of Arran Chief grown continuously at Ashburton for several years, sent down to be grown at West Plains, near Invercargill, for one season and returned to Ashburton, has not benefited by the change. This is contrary to expectations, but it will take several seasons to prove the point.

There is no evidence to support the statement that a change from one soil-type to another is beneficial. All the evidence points to the fact that the benefit to be derived from a change is a measure of the relative freedom from virus disease in the introduced line. The point is very important, and growers should realize that the indiscriminate exchange of seed is likely to result in no benefit, and should be carried out with a definite objective. Since avoidance of virus disease is the

sum total of the proved benefits from a change of seed, it is obviously very important that a survey should be undertaken to determine the distribution of virus disease in New Zealand.

Variation in the Potato.

The nature of variation in the potato has been the subject of much investigation in recent years. It is not intended to discuss this here, and it is sufficient to say that these variations may be termed somatic or germinal according to whether they are heritable or not.

Somatic variations do not arise from or cause any change in the germ plasm; they are non-heritable variations due to environment. Such characteristics as cooking-quality, shape, and roughness of skin in any particular variety are modified by soil and climatic conditions, and, while such modification may cause confusion in the identification of varieties, they are transient, and play no part in the production of new types. Germinal variations differ from somatic in that they are heritable, and under that heading are classed mutations. A mutation is a plant which shows some sudden variation not attributable to cross-fertilization. Mutations in the potato are most commonly observed as changes in the texture and colour of the skin, although there is some doubt whether all or only some of these variations are true mutations. They may be due to the addition of a character not previously observed, as in the coloration of Maori Chief, said to be a mutant from Gamekeeper, itself a selection from Northern Star. More often they represent the loss of a character, as when white tubers arise in a coloured variety. Except for the russet skin, Field Marshall is identical with Up-to-Date, in which it may have arisen as a mutant. Golden Wonder is a russet-skinned replica of Langworthy. There are instances in which the flower has changed colour, and the variety General is a white-flowered President (Iron Duke).

The discovery of these variations is almost always a source of temptation. The grower has at hand, ready-made, an old variety under a new guise, and he is tempted to add it to the all too long list of varieties now being grown. It may therefore be wise to quote the following from Dr. Salaman's book, "Potato Varieties": "It may be concluded that a mutant form which differs from the normal type by the loss of colour in the flower or the skin of the tuber, and to a still greater degree if in both, is extremely unlikely to exhibit any character which would render it superior. Indeed, such mutants are, in general, inferior in both yield and vigour to the normal type. . . . Enough has been said to show that it is not by way of bud-mutations that we must look for new varieties, for such undoubted ones as have occurred amongst our domestic strains have failed to produce any form superior to their immediate parent."

Two other types of variations, known as "bolters" and "wildings," are to be found in many varieties. Nothing definite is known as to their origin, although some authorities regard them as mutations.

Bolters: These may be most commonly observed in Up-to-Date and Epicure, and are most easily recognized in the latter. The plants are tall and late-maturing, and produce a relatively large number of flowers. They are more resistant to such diseases as early and late

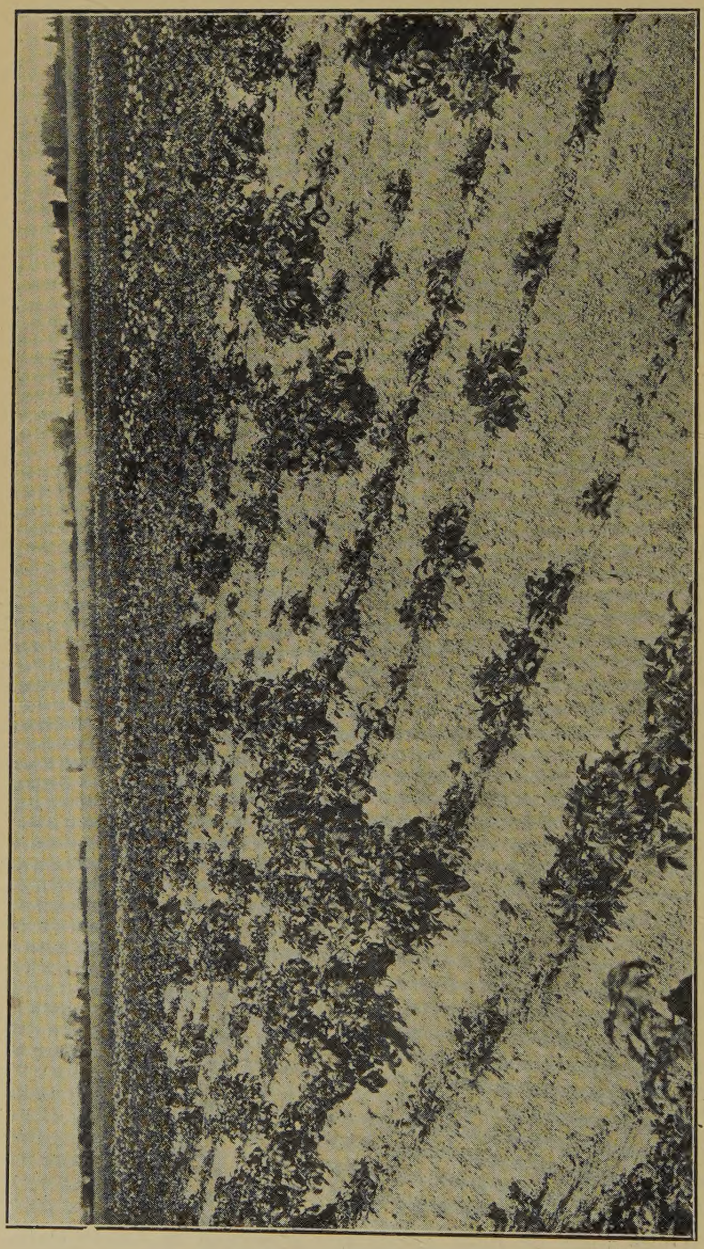

FIG. 7. A DEGENERATE LINE GROWING AT ASHBURTON EXPERIMENTAL FARM.

This seedling became infected with virus disease while being grown at the Moa Seed Farm, Central Otago, but, in common with a large number of other seedlings and commercial varieties, did not show these degenerate symptoms till transferred to Canterbury. In the 1926–27 season it was grown at Ashburton, and the illustration is of the 1927–28 crop. It will be seen that certain plants have evaded infection, and some selections of these made during 1926–27 have remained healthy. This is fortunate, because the seedling in question has very promising commercial possibilities. It is a case in which the early digging of single-plant selections affords the only hope of success. [*Photo by H. Drake.*

blight. The stolons are long and the tubers large and coarse. Such plants should be rogued, for they represent an undesirable variation from the normal, more especially in an early variety such as Epicure.

Wildings: These plants are short, and produce an abundance of stems bearing no flowers. As might be expected, such a plant will produce a large number of seed-size tubers with few table potatoes, and the stock may deteriorate very rapidly. The variety grown under the name of White Beauty of Hebron produces a number of wilding plants.

One might be permitted here to say that there is no foundation for the oft-repeated assertion that the presence of rogues and variations is due to "inoculation by bees." Bees play no part whatsoever in this connection.

Potato Selection.

The potato is reproduced asexually from tubers, and the tuber is an underground stem which has been modified for the storage of food to be used by the plant during the early growth of the following season. One would not expect a rose-cutting to develop any variation from the parent plant, except in the very rare case of bud-mutation. Nor would one expect any variation to occur in the potato from one season to the next. So long as the plant remains healthy and in normal surroundings it produces indefinitely a replica of the original plant both in regard to appearance and cropping-power. Very occasionally bud-mutations occur, and may afford material for selection, but, as already stated, they are apt to be inferior to the parent variety.

One must conclude, therefore, that selection within a variety leads to no improvement; and such would be the case were it not for the fact that the potato will show great variation in degree of degeneracy, and therefore a corresponding degree of variation in cropping-power. A potato-field is populated with a number of individual plants, and even if all environmental variation is removed they will exhibit all degrees of cropping-power, depending upon whether or not disease is present. Upon this fact is based the whole principle of potato-selection, and it virtually becomes an evasion of those diseases causing degeneration.

It is at once apparent that selection must be made at a time when these conditions can be recognized—that is, during the growing season (Fig. 3)—and it is equally obvious that the selector must be able to recognize a degenerate condition when he sees it, which ability can be acquired only with experience. The tuber to be used for planting is the chief factor in distribution, for it carries the degenerate condition of its parent one step further (Fig. 4). It is also necessary to remember that these diseases are transmitted in the field by such agencies as the green aphis, and that a plant recently infected may show little or no symptom till the tubers are grown and the resulting plants inspected.

METHODS OF SELECTION.

There are two chief methods of selection, and it will be noticed that no reference is made to the hand-picking of seed after harvest, for this, although so commonly adopted, affords little or no selection whatever.

Mass Selection.—As the term implies, this is effected by collecting together a large number of individuals, and whether it is likely to be of any value will depend upon the standard of the individuals which comprise the mass. The least effective method is to earmark a section of the main crop for seed and to rogue all undesirable plants. The writer considers that rogueing, whether in potatoes or other crops, is a most ineffective means of cleaning up deteriorated stocks, and does not recommend it where other means are possible.

The use of cut table tubers has already been fully discussed in this connection, and needs no further comment beyond saying again that this method affords a very satisfactory means of effecting general improvement.

An improvement upon either method is effected by harvesting individual plants. It has already been stated that selection must take place when the rogues and degenerate conditions can be observed, and a commencement should be made during flowering. Armed with a number of sticks, the grower should go through his crop and mark as many "true to type" healthy plants as time will permit. These should be examined periodically till dug, and the stick removed if for any reason the original decision is reversed. It might be wise to mention again that "bolters," being more disease-resistant than their neighbours, are likely to appear promising in the eyes of any one not forewarned.

The marked plants should be dug in an immature state shortly after flowering and before the tops shows signs of maturing. They should then be greened, or stored in trays for greening and sprouting. By this means sufficient seed could be procured for the planting of a seed-production plot. The seed-plot should be isolated, and, as already mentioned, probably the worst location would be a few rows down the centre of the main crop.

This system of selection would appear to be the most effective for a practical grower to adopt, and if persevered with, and the seed plots carefully rogued, would undoubtedly repay him many times for his labour, and stimulate his interest and pride in his particular line

Individual Selection.—While bulk selection consists of bulking together the produce of a number of selected plants, individual selection may be described as the selection of individual plants, and by the growing and multiplying of these individuals determining with a greater degree of certainty that what appears healthy is in reality so and will produce healthy stock (Fig. 5).

In what is termed "hill selection" the tubers of an entire hill are planted out, and the produce of each is kept separate until such time as it has proved its merit. This method has been superseded by tuber-unit selection, in which one tuber from the selected hill is cut into four sets and the produce of each tuber kept separate as in hill selection.

Tuber-unit selection has many advantages over the hill method, but both are more within the province of the professional plant-selector. They are liable to fail if undertaken by a commercial grower, because of the slow increase, the large amount of detail involved, and the danger of reinfection resulting from insufficient isolation.

(*To be continued.*)

CRACKING OF DUNN'S AND COX'S ORANGE APPLES.

INVESTIGATION IN NELSON DISTRICT.

J. A. CAMPBELL, Director, Horticulture Division.

DURING the past few years fruitgrowers in different parts of New Zealand have suffered considerable anxiety and loss through the russeting and excessive cracking of certain varieties of apples, particularly the Dunn's and Cox's Orange varieties. In part of the Nelson District this condition appeared to be going from bad to worse each year. The Department of Agriculture and the Cawthron Institute were, naturally, called upon to institute investigations with a view to determining the cause of the trouble and methods of control. Early in the history of the trouble the Orchard Instructor at Mapua, Mr. B. G. Goodwin, gave growers very sound advice—namely, to thoroughly cultivate and manure their land, and to prune their trees severely with a view to getting rid of all weak and exhausted wood, to promote the formation of new growth, and to generally stimulate a more vigorous growth of the tree. The investigations carried out by the Biological Laboratory of the Department largely confirmed this advice.

Although the russeting and cracking referred to is still in evidence, a very marked improvement was noticeable last season where heavier pruning, &c., had been practised. In consequence of this the following questionnaire was issued in April last to those growers of the Nelson District who were held to be in a position to furnish information :—

(1) Have you experienced the russeting and cracking of Dunn's and Cox's Orange apples ?

(2) Does your experience suggest that it is due to a disease, or that it is physiological trouble arising from causes remediable by means of improved cultural methods ?

(3) If the former, on what do you base your opinion ?

(4) If the latter, is your opinion the result of actual practice ? If so, what cultural methods varying from those practised in your orchard previously have you adopted to overcome this ?

The following is a summary of the replies received :—

Twenty-one growers replied as having experienced cracking. Of these, nineteen are of opinion that the trouble is physiological, and two are of opinion that it is due to disease.

Of the nineteen who are of the opinion that the trouble is physiological, fourteen include hard pruning in their system of control. Of these, five mention hard pruning as the only special feature of orchard management necessary; five add good cultivation and manuring; three make the further addition of the use of non-caustic sprays; while the fourteenth relies on hard pruning and the use of non-caustic sprays. Of the remaining five, one bases his success on cultivation and manuring only, another on the same plus the use of non-caustic sprays, while a third reports success through omitting bordeaux in the spring and the use of atomic sulphur plus lime-sulphur in the summer; the remaining two report no success.

Growers Nos. 20 and 21, who blame disease, hold that it can be controlled, one by using Sulpho with lime-sulphur during the summer, and the other by hard pruning, good cultivation, and by adding plenty of plant food to the soil.

Notwithstanding the fact that the majority of the growers communicated with are of opinion that the trouble can be overcome by cultural means, continued close attention will be paid to the matter by the Department until this is definitely confirmed or otherwise. In the meantime the experience of growers, together with details as to experiments undertaken—whether successful or otherwise—if forwarded to the Department from time to time, will be appreciated.

BREEDING OF ROMNEY-CROSS SHEEP.

WALLACEVILLE WOOL-IMPROVEMENT DEMONSTRATION.

J. G. Cook, Wool Instructor, Live-stock Division.

In an article published in the *Journal* for April, 1925, the writer dealt with the improvement in wool fibre of a small flock of ewes at the Wallaceville Veterinary Laboratory Farm, near Wellington, when it was indicated that information in regard to further operations would be given at a later date. In the first place it may be mentioned that particulars have already been given as to the three successive Romney rams that were mated with the ewe flock in the period of five years covered. The third ram purchased was used for one year only, owing to the fact that he was not quite the type required.

During the sixth year (1925) another Romney ram was purchased at a cost of £12 12s. This animal was a late lamb, and it was anticipated that he would fill up well as a four-tooth. He had good conformation, constitution, and wool, but was inclined to be rather short in the leg. He did not grow to the height expected; nevertheless he produced some good stock, and his lowest lambing result was 124 per cent. This ram was retained for three years, mating him with the same ewes each year, no inbreeding being done the third year.

A Romney ram was generously donated to the Department early in the present year (1928) by a prominent sheep-breeder who is keenly interested in the work at Wallaceville. This ram has splendid constitution and conformation, with good wool showing character and density—very desirable features.

Throughout the demonstration only Romney rams have been used. Several objects have been in view—namely: (1) To show the improvement that can be effected in a rough cross-bred ewe flock when care and judgment are exercised in selecting the rams; (2) to keep the price paid for the rams at a moderate figure, within the reach of the average sheep-farmer (the average price for the rams purchased, transit charges included, amounting to £11); (3) to prove that a Romney ram carefully selected for purity of wool fibre can soon effect a marked change in the clip.

PORTION OF THE EWE FLOCK AT WALLACEVILLE LABORATORY FARM. [*Photo by H. Drake.*

The following particulars summarize the later records similarly to the previous article :—

Year 1925 : Ram No. 4 purchased. Constitution, conformation, and wool good ; only fault rather short in leg. This ram was mated with the same ewes for the years 1925, 1926, and 1927.

Year 1928 : Ram No. 5 has been used. It is intended to keep some of the ram lambs of his progeny, and sell them after they have been shorn as hoggets during November, 1929.

A small relevant experiment may be briefly recounted here. A statement was published in a foreign paper some little time ago to the effect that supposing wool growing on a sheep showed pith (hairiness) at the tip of the fibre, but such pith disappeared gradually lower down, leaving the remainder of the fibre pure wool, if the sheep was not shorn at the same time in the following year then the fibre would revert back. In effect this means that the pith would appear and disappear at the same time each year. In order to ascertain whether this hypothesis could be proved arrangements were made for six of the older ewes and four of the hoggets in the Wallaceville flock to be left unshorn at the general shearing during November, 1927. They were shorn towards the end of March, 1928, when the ewes were carrying sixteen months' and the hoggets eighteen months' growth of wool. One of the ewes was six years old, and was of the progeny produced by the first Romney ram used. In the previous year the breech wool of this ewe had been showing signs of going back—that is, part of it down the hind legs was showing hairy wool tendencies. She was kept to see if any further retrogression took place in that portion of the fleece. The lower part of the breech wool had some fibres in it showing pith at the tip, but this pith disappeared as one examined down the length of these fibres, the rest being pure wool. In no instance was it noticed that the fibres reverted back to the pith appearing at the same time as during the previous year. The ewes and hoggets whose wool was pure at the tip had pure wool at the base of the fibres, irrespective of their length or the time the wool had been on the sheep. It may be mentioned that this wool was sold at the Wellington sale on 26th March last, and realized up to 23½d. per pound.

The operations recorded in this and the previous article have proved to be a very interesting study. The line of breeding, selection and mating, degree of culling, fertility of the soil, palatability of the pasture, climatic conditions, lambing, dipping, and other matters entailed in the management of a flock all enter into consideration in such work. Sheep-farmers out to improve their flocks intelligently on similar lines will find the time and thought involved well spent

Insect Parasite of Piripiri.—With reference to the note by Mr. D. Miller on this matter in last month's *Journal*, further communications have been received by the Noxious Weeds Control Committee from Brother Claude Joseph, in Chile. He emphasizes the great vital resistance of the larva and the fact that, as it can feed on any species of *Acaena*, it would probably adapt itself to New Zealand conditions. The species hibernates in the larval stage buried in the ground, a circumstance which would make transit to New Zealand easy.

SURVEY OF DISEASES OF CEREALS IN NEW ZEALAND.

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Diseases of Wheat.

RUST.

Two species of rust are present on wheat in New Zealand—brown or blade rust (*Puccinia Elymi*) and black or stem rust (*Puccinia graminis*) Of these the former appears earlier in the season and is more generally present, over 90 per cent. of the crops examined in 1926-27 being infected. As a rule the infection was light, but in favourable localities and seasons very heavy infection occurred. The season 1927 28 was not favourable for rust development, only 26 per cent. of the crops examined in Canterbury showing infection, and that rarely more than a trace. Black rust (*Puccinia graminis*), judging by the survey data over the last three seasons, is not a very serious disease of wheat in New Zealand. Where present it has appeared only on crops almost fully mature, and it is possible that some crops which were apparently free at the date of inspection showed later the presence of the disease. In 1926–27—a year favourable to rusts—18 per cent., and in 1927–28 5 per cent. of the crops examined in Canterbury were infected, and in no case was the infection severe.

SMUT.

Two types of wheat-smut are present in New Zealand—stinking smut (*Tilletia Tritici* and *Tilletia levis*), and loose smut (*Ustilago Tritici*). The former is generally present to a small extent in a few crops in every district, but its incidence is slight, owing to the almost universal adoption of seed-disinfection. Loose smut varies in incidence according to the variety of wheat. Hunter's wheat, practically all of which is now College Hunter's—that is, the product of the Canterbury Agricultural College selected strain—is invariably free from infection. Velvet Chaff only rarely shows a trace of infection, though the variety Velvet Ear or Solid-straw Velvet, largely grown in South Otago, always shows from a trace to 3 per cent. of loose-smutted heads. Solid-straw Tuscan, comprising 75 per cent. of the wheat grown in New Zealand, shows in general a small percentage of infection, as a rule less than 1 per cent., but in occasional crops rising as high as 8 per cent. From the data collected it appears that loose smut is slowly but steadily increasing in Solid-straw Tuscan throughout the country. The other long-berried wheats commonly grown—White-straw Tuscan, Purple-straw Tuscan, Dreadnought, and Major—all show a very definite percentage of the disease. White-straw Tuscan in particular is invariably heavily infected, smutted heads varying from 6 per cent. to 24 per cent.

TAKE-ALL *(Ophiobolus graminis)*.

This disease appears to be the most serious disease of wheat in New Zealand—judging at least by last season's survey. A careful and conservative estimation, based on the crops examined, puts the direct average loss for New Zealand at 5·5 per cent. All varieties appeared

equally susceptible to the disease, but in certain localities, such as North Canterbury and North Otago, its incidence was more pronounced.

WHITE-HEAD *(Cause not yet determined).*

This condition was observed in many crops, but, except where take-all was in evidence, rarely was more than a small percentage of the heads affected.

MILDEW *(Erysiphe graminis).*

Mildew is generally present on wheat in New Zealand, but only when climatic and other conditions are particularly favourable does its incidence become severe.

SCAB *(Gibberella Saubinetti).*

Like mildew, this disease is generally present to a slight extent on New Zealand wheats. Occasionally a crop, or portion of a crop, is met with that shows severe infection on every head, but the conditions which determine this or the loss it causes are points that are still obscure.

Table 1.—Percentages of Wheat Crops examined which showed Infection by respective Diseases.

District.	Number of Crops.	Brown Rust.	Black Rust.	Loose Smut.	Stinking Smut.	Take-all.	White-head.	Mildew.	Scab.
				1925–26.					
Marlborough	18	72	11	72	5	0	0	0	..
Canterbury	198	49	0·5	36	3	9	45	8	..
Otago ..	38	16	2	50	2	0	0	8	..
Southland ..	10	0	0	60	20	0	0	0	..
				1926–27.					
Marlborough	33	91	0	85	0	12	0	0	0
Canterbury	430	96	18	30	6	13	30	7	26
Otago ..	37	89	73	51	11	16	0	35	70
Southland ..	11	91	45	91	36	72	0	27	9
				1927–28.					
Marlborough	51	86	2	82	2	20	33	23	2
Canterbury	547	26	5	53	9	37	42	90	87
Otago ..	62	53	19	64	14	35	27	50	71
Southland ..	19	21	0	100	42	47	47	26	84

Diseases of Oats.

RUST.

Two species of rust are present on oats in New Zealand—crown or blade rust (*Puccinia coronata*) and black or stem rust (*Puccinia graminis*). In the South Island (no survey has been made of the North Island oats) the former predominated in the rust-favourable 1926–27 season, while in 1927–28 only a trace was observed in a few crops, and in several localities it was absent altogether. Even when commonly present, as in 1926–27, the amount of leaf-surface affected by the rust was rarely high. Black rust, on the other hand, in 1926–27, in certain localities, and especially in late-maturing crops, was very severe in its incidence,

every part of the plant, leaf, stem, and head being covered by the rust pustules. In 1927–28 only very rarely could more than a trace be detected, and many localities were free from infection altogether.

SMUT.

Two species of oat-smut are present in New Zealand (*Ustilago Avenae* and *Ustilago levis*), but, since accurate differentiation in the field is difficult, and their life-histories, effects, and methods of control are similar, they are considered here as one. Smut is common in New Zealand in all districts and on all varieties of oats, with the partial exception of Algerians, which are seldom heavily infected. The loss caused by the disease has been very greatly reduced during the last two seasons, except in the Marlborough District, owing to the more general adoption of seed-disinfection. This reduction is much greater than the tabular presentation of the survey results would indicate, since, though the current methods of seed-disinfection reduce the amount of smut to small proportions, disinfection of infected seed is rarely complete.

LEAF-SPOT (*Septoria gramineum*).

This disease is present on most oat crops in New Zealand, but the lesions rarely occupy more than a small proportion of the leaf-surface. It is more prevalent in wet localities.

WHITE GLUME.

This condition, probably of physiological origin, is fairly common on Garton and Sparrowbill oats, but rare on Algerians and Duns. Only occasionally does it appear to cause any material reduction in yield.

Table 2.—Percentages of Oat Crops examined which showed Infection by respective Diseases.

District.	Number of Crops.	Crown Rust.	Black Rust.	Smut.	Leaf-spot.	White Glume.
			1925–26.			
Marlborough ..	12	0	17	17	0	0
Canterbury ..	91	3	1	65	27	0
Otago	100	1	0	88	0	0
Southland ..	110	1	0	90	0	0
			1926–27.			
Marlborough ..	52	25	21	46	23	0
Canterbury ..	256	43	40	93	72	45
Otago	129	85	61	90	83	73
Southland ..	115	90	84	90	90	88
			1927–28.			
Marlborough ..	104	15	21	50	72	25
Canterbury ..	246	5	25	66	93	69
Otago	94	15	46	72	73	54
Southland ..	116	0	45	87	89	7

Diseases of Barley.

RUST.

Only one species of rust (*Puccinia anomala*) is present on barley in New Zealand. The season 1926–27 was a favourable one for rust development, and the large majority of barley crops were affected, though infection was not often severe. In 1927-28 infection was much less in Marlborough, and practically absent in Canterbury and Otago.

SMUT.

There are two species of smut present on barley in New Zealand—Covered smut (*Ustilago Jensenii*) and loose smut (*Ustilago Tritici*). Until the last two seasons the former smut has been very common in New Zealand barleys and the cause of very serious losses. The growing of malting-barley of late years, however, has been largely controlled by the commercial interests interested in the product, and this has resulted in great attention being paid to efficient seed disinfection and selection. The consequence has been that the loss from covered smut in malting-barley last season was practically nil, the few crops still showing its presence having in no case more than a trace. The position, however, is very different in the case of feed barleys, which are not controlled, and which, moreover, are often originally intended for feeding-off green and allowed to mature for harvest as an afterthought. These barleys are almost invariably smutty, and provide a constant source of possible reinfection—through threshing-mills and cleaning plants—of the clean malting-barleys. Loose smut has not been observed during the past two seasons on any malting-barley in New Zealand. Feed barleys, especially the variety Russian Cape, are usually infected.

TAKE-ALL *(Ophiobolus graminis)*.

This disease was observed in a few crops only.

WHITE-HEAD *(Cause not yet determined)*.

This condition, which is usually associated with fungus attack at or below ground-level, is often present in New Zealand barley, but seldom affects more than a few isolated heads in the crop.

MILDEW *(Erysiphe graminis)*.

Mildew was present in a few crops during the last two seasons, but its incidence was never severe.

STRIPE *(Helminthosporium gramineum)*.

This disease was observed on almost all barley crops in 1927-28. In most cases the only symptoms observed were small but characteristic lesions on the lower leaves, a character not recognized as diagnostic during the previous year's survey (thus accounting for the apparent large increase in incidence shown in the table). In some crops, however, and particularly in Cape barley, the disease became more severe in its attack, resulting in many shrivelled and distorted heads.

Table 3.—Percentages of Barley Crops examined which showed Infection by respective Diseases.

District.	Number of Crops.	Rust.	Covered Smut.	Loose Smut.	Take-all.	White-head.	Mildew.	Stripe.
			1926–27.					
Marlborough ..	49	87	51	2	0	5	2	36
Canterbury ..	69	95	72	6	6	2	3	7
Otago ..	19	84	47	16	0	21	0	26
			1927–28.					
Marlborough ..	24	66	9	4	8	66	4	79
Canterbury ..	114	3	41	2	9	47	12	92
Otago ..	22	0	41	0	0	23	0	95

CROW GARLIC AND ITS CONTROL.

STUDY IN WAIKATO DISTRICT.

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CROW garlic (*Allium vineale*) is by no means a common weed in New Zealand, yet wherever it makes its appearance on grassland it should be regarded as an intruder and serious efforts should be made to eradicate it. Like all members of the onion family, this weed has a characteristic penetrating odour, and it requires no effort of imagination to suspect it capable of tainting milk and cream from cows pastured upon it. In the Cambridge locality, where the matter was studied, it is usual for certain farmers to receive complaints each autumn and spring regarding tainted milk sent forward to the factories. Several of these farmers were visited and the garlic studied on their farms. The suggestions which follow are therefore based upon local conditions in the Waikato.

It will be well to give a short life-history of this weed before proceeding to deal with those factors which are important in its control and ultimate suppression. The "seed-heads," which appear in December, are borne on an elongated stalk some 3 ft. to 4 ft. high. These seed-heads are really clusters of small bulbs or "bulbils." At first these are enclosed in a filamentous covering, which bursts as the bulbils ripen and swell. At the end of December the bulbils are ready to drop off, and those that find congenial surroundings almost immediately take root. By March the young plants are well established. The bulbils may fall into drains and be carried a long distance by the water before being arrested. The spreading of crow garlic in the area studied has largely been effected in this way. The garlic can be readily pulled by hand just at that stage when the bulbils are ripening and have burst their filamentous covering. The parent bulbs in the ground are then quite close to the surface, and the seed-stalk is quite woody and does not break in the hand.

The accompanying photograph (Fig. 1) shows the ripe seed-heads. The bulbil clusters can be seen at the top. Those on the right are

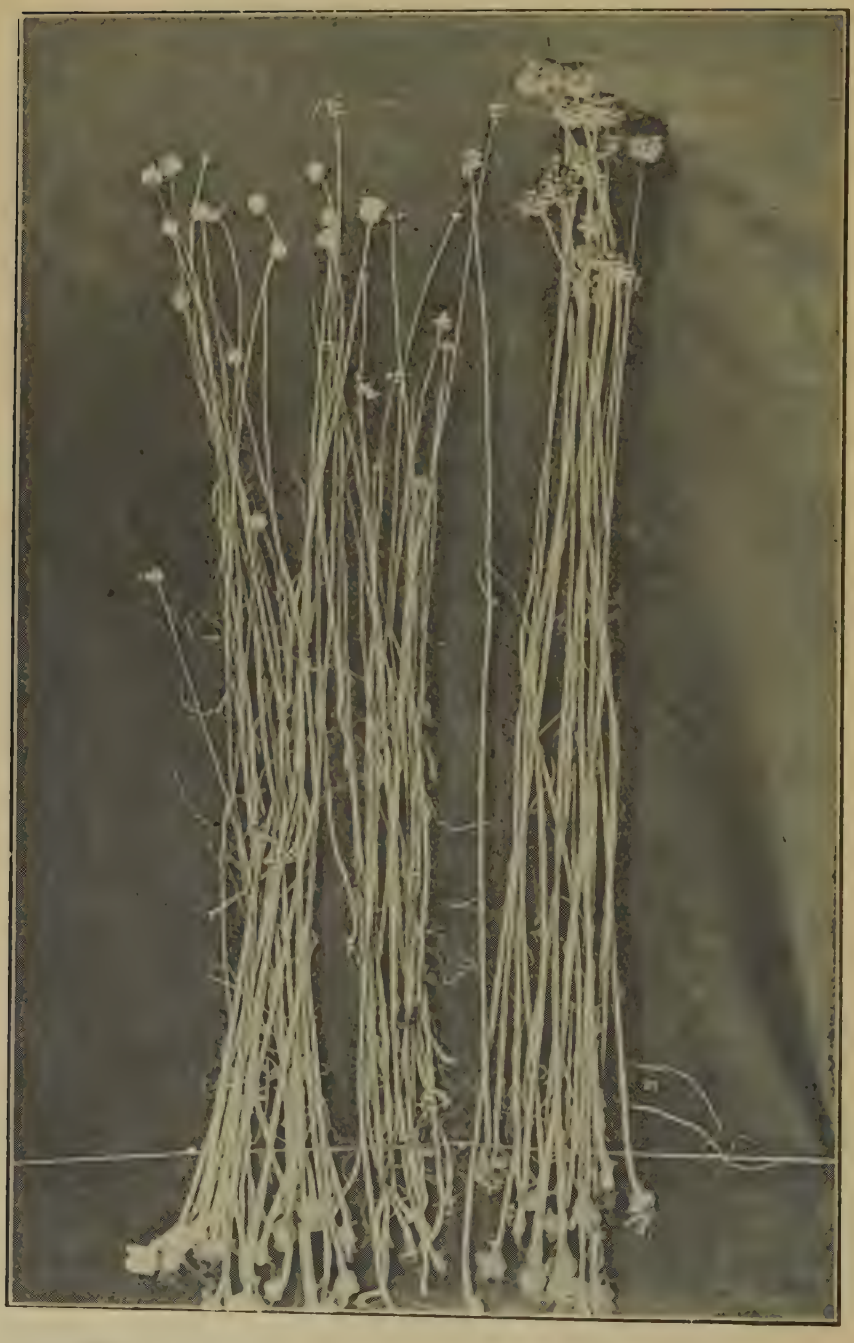

FIG. 1. CROW GARLIC, SHOWING BULBS AND RIPE "SEED-HEADS."

barely ripe, while those on the left are at the best stage for pulling by hand. In both these groups the parent bulbs can be seen at the foot, also small attaching bulbs which often split off and so propagate afresh. No matter how carefully the pulling is done, many of these split bulbs will be left in the ground. This propagation from split bulbs, as well as from the prolific crop of bulbils on the seed-stalk, makes crow garlic a most troublesome weed to deal with. The central group in the photo was pulled by hand from a patch that had been sprayed by an arsenical compound. The bulbils are largely withered and dead. The parent bulbs are also shrivelled, but in pulling the split bulbs have all been left in the ground, as the parent bulb has shrivelled away from them. Split bulbs will grow and reproduce fresh plants, as shown diagramatically in Fig. 2.

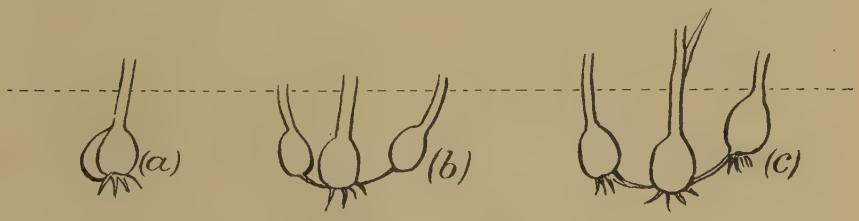

FIG. 2. SHOWING REPRODUCTION OF CROW GARLIC BY "SPLITTING" OF BULBS.

(*a*) Splitting commenced; (*b*) new bulbs formed; (*c*) new bulbs forming roots and leaves.

During the investigation four different spray compounds were used in an endeavour to kill off the garlic, two being non-poisonous sprays and two arsenical compounds. After three sprayings, with uncertain results, the work was discontinued, as the cost had become prohibitive. The young establishing plants were killed out to a large extent, but apparently the mature bulbs were only affected at seeding-time, with the result seen in Fig. 1. In these cases also the split bulbs were not affected, and so could propagate anew.

From a study of the weed in the field, however, it seems certain that control and absolute prevention from spreading can be obtained by controlled stocking with cattle and sheep. Crow garlic flourishes along headlands, hedgerows, drains, &c.—wherever there is ungrazed land or where cattle have only occasional access. Furthermore, in those instances where the garlic had spread to the surrounding grassland it was found that this pasture had not been top-dressed with artificial fertilizers, and had been grazed only on odd occasions. In the dairying district studied, it was usual to find the garlic along the headlands, &c., and even a few feet inside in the pasture, but not farther than the limit imposed by the top-dresser. This clearly points to the fact that its further spreading into the pasture was prevented by the stock grazing on the sweet top-dressed area. Even if the garlic had appeared in the pasture, the constant browsing by the stock and the heavy tramping received had clearly crushed it out.

From the life-history given it will be seen that garlic-infested land should be heavily stocked by sheep or cattle when the young plants are just establishing and tender. This is during February and March

in the Waikato. If the land is used for dairying there is a likelihood of milk tainting at this time, so that sheep or dry cattle should be brought to bear on the infested areas. As the garlic appears only in waste places in the locality studied, these places must be top-dressed to induce stock to seek their food there. Such manures should therefore be applied in early February, as soon as rains have fallen. The pasture should then be grazed heavily as soon as possible. Usually this top-dressing will have to be done by hand to be effective. It should also be liberal—in fact, the infested areas manured more heavily than the adjacent garlic-free pasture. Where a high hedge shelters the garlic it may pay to trim this down and let in the sun to sweeten the grass below. The rank grass under tall shelter is never so acceptable to stock as the sun-exposed open pasture.

During June and July the whole herd can be brought to bear upon the infested areas, and it is during these months that garlic is especially vulnerable. During spring, when dry stock only can be used, it may be necessary to scythe the infested areas until December, after which practically no growth is made until autumn. On no account should garlic be allowed to seed. The feeding-out of hay, ensilage, &c., along garlic-infested areas is not advised, for although the land will be the more heavily tramped it will also be fouled, and the same hard grazing by the stock will not be attained. That systematic grazing and spelling of pastures is the only successful way to manage grassland will be admitted by every thoughtful dairy-farmer. Weeds of all kinds flourish on the neglected headlands ; on the other hand, as the pasture is built up by complete artificials, efficient management by systematic grazing and spelling, and the right use of the tripod harrows and mower, so the rye-grass-dominant sward comes in to oust these weeds. Garlic can be added to the long list of weeds that will not survive under intelligent grassland management.

If garlic is infesting intercultivated crops on arable land, careful hand pulling in December should follow the thorough intercultivation given up to that time. All the pulled material should be burnt, as garlic does not wither away in the sun. If possible the land should be laid down to permanent grass in February. The seed-bed should be rolled and well compacted, and liberally manured to force on the young pasture. The more weedy the land, the heavier should be the manuring for grassland when it is establishing. As soon as possible dry cattle or big mobs of sheep should be pastured on the field. This should continue until the dairy herd is available for grazing the pasture from June onwards. It is useless to close such a pasture for hay, as the garlic seed-heads are ripe at haying-time. Provided the making of early ensilage is certain, then the field can be closed to stock, but it must be harvested in early November. Only the leaves of the garlic-plant will be obtained in this ensilage, and the fermentation processes set up in the silage pit or stack will largely render innocuous the pungent material. After the mowing of the field at this stage the garlic will make no growth until the following February, so that in the interval systematic stocking can be brought to bear upon the area, and thus the "aftermath" will be closely grazed. This systematic grazing must be followed up during March when the young plants are just appearing.

STRAWBERRY-GROWING IN NEW ZEALAND.

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VARIETIES.

THE varieties of strawberry grown are innumerable, as the plant is readily raised from seed. It is not intended, however, to give a complete list or even a description of all well-known varieties in this article, but rather to deal with those that are grown commercially in New Zealand.

In most parts of Auckland Province the Marguerite is the principal one grown commercially. The berry resembles a blunt wedge in shape, and grows larger than most other varieties. When ripe the flesh of the berry is extremely soft, and therefore it cannot be considered a good carrier, being very susceptible to bruises. Its flavour is not equal to the best, but this fact is largely lost sight of by the average consumer, as the excellent appearance more than compensates.

In the extensive strawberry-gardens of Nelson and Hawke's Bay Provinces the Melba variety predominates. The fruit is considerably smaller than that of Marguerite, and is conical in shape. It is superior to Marguerite in flavour and equal in firmness.

The Etesburgh variety is not uncommon in parts of the South Island, but is seldom found in the North Island, though it has been tested in most localities and in various soils. The berry is spherically shaped and is smaller than Melba. The flesh has a very firm texture, and therefore carries well. The flavour resembles that of a pineapple, and must be considered excellent.

A well-known English variety, the Royal Sovereign, is sometimes met with in New Zealand gardens, principally in the South Island. While the flavour and size of this berry leaves little to be desired, it is not grown extensively, principally because it is not a heavy cropper in most strawberry-growing localities.

A variety that has of recent years made its appearance on the Auckland markets is Captain Cook. In appearance, texture, and flavour this fruit is very similar to Melba, and when better known may become a very popular strawberry. The fruit ripens slightly earlier than Marguerite, and plants give better results than the latter variety when retained for the second season.

The Everbearing is another variety that is seldom seen in our markets, but which appears to have outstanding qualities when grown under suitable conditions. The fruit is almost equal to Marguerite in size, and quite equal in flavour and texture. The class of soil best suited to the Everbearing appears to be a light sandy loam, which is unsuitable for many other varieties.

Laxton's Noble is giving good results where grown in the southern parts of the South Island, and is gaining popularity there on account of its size and appearance. The fruit resembles in many ways that of the Marguerite.

Many other varieties of strawberries can be found growing in New Zealand, but none are of sufficient commercial importance to warrant

a description here. Of the seven varieties named above Marguerite and Melba surpass all the others as regards the quantity grown, consequently the remarks which follow will principally treat with those two varieties. It can be generally taken that Marguerite is the principal strawberry grown in Auckland Province, and Melba in the more southern districts. However, a fair quantity of Melba has been grown in Auckland of recent years, and the variety is reported to be giving satisfactory results.

SITE AND SOIL.

In selecting the site for a strawberry-garden it must be remembered that the earlier in the season the fruit ripens the greater the price that fruit will command on the markets. Consequently it is best to choose a warm site, preferably with a gentle slope towards the north or north-east, and well protected from cold winds.

Both the Marguerite and the Melba varieties will give excellent results when grown in a friable clay loam with a porous subsoil. However, they are not exacting, and many other classes of soil will often give results that leave nothing to be desired. Most varieties will not thrive satisfactorily on a very light or sandy soil.

CROPPING-HABITS.

Strawberry-plants have been known to survive for a period of ten years without transplanting, and when transplanted every alternate year will often endure for several years longer. For commercial purposes the life of a plant may be considered as not more than three years. Variety, soil, and certain pests and diseases are all important factors in determining the profitable period. In Nelson District plants of the Melba variety can usually be left unmoved to advantage for a period of three years from the time of planting; but only in most exceptional cases, when the plants show particular vigour, will it be found profitable to allow them to remain for a fourth season. In gardens where the majority of plants have made poor growth during the first season after planting, or where diseases or pests have appreciably reduced their vigour, it is unwise to allow them to remain for the third season's crop. Most of the successful growers in Auckland Province consistently replant their gardens every season. Some growers in the district have been known to allow their plants to remain unmoved until after the second season's crop has been harvested, but the result in almost every case has been small-sized fruit.

Blooms are frequently produced in the winter and early spring months before the young plants have grown sufficient new roots to become firmly established. These blooms should invariably be removed as soon as they appear.

The Melba variety usually ripens its first fruits of the season at the beginning of November. This date, however, may vary as much as ten days either way, according to seasonal conditions and locality. The crop usually continues until about the third or fourth week in December, and sometimes later in the southern provinces. When a very dry season is experienced the cropping period may be shortened by two weeks. Melba invariably produces a second crop annually, which commences to ripen about the first week of February and often continues

until April. While the second crop is spread over a much longer period than the first, and the fruit is usually of a superior size and flavour, the quantity produced is considerably less than in the first crop. When a very dry summer and autumn are experienced, the lightness of the second crop may make the gathering so expensive as to reduce the net value of the crop to a negligible amount. When a wet summer and autumn are experienced the second crop may be expected to yield more than half the amount of the first.

The Marguerite variety yields only one crop annually, and the period over which this extends is usually from one to two weeks longer than that of the first Melba crop. The first berries to ripen will generally be a few days later in the season than with the other variety. The quantity of fruit produced by Marguerite compares more than favourably with the quantity of the main Melba crop, and frequently equals as much as both of the Melba crops combined. In this connection it should be noted there are many different strains of Marguerite, some producing far less fruit than others. Therefore growers when purchasing plants should exercise the greatest care to secure plants known to be of the best strain.

PLANTS.

When a young plant is first set out it is approximately six months old and has a single crown. During the first season after planting out, this nucleus crown not only increases in size but also produces many other offset crowns which cluster round the parent plant. A strong-growing plant will sometimes produce as many as twelve or more crowns during the first season; six to eight crowns is considered a good average two-year-old plant. Growers sometimes follow the practice of breaking up the crowns of the previous year's plants and replanting them as they would a young plant. These second-year plants, as they are termed, often thrive well and yield a fair crop of fruit, but must be considered inferior to young plants; therefore this practice cannot be recommended.

In the suburbs of Auckland City, which are noted for the quality and quantity of strawberries produced annually, young plants are almost invariably used. These plants are not raised by the growers of the fruit, as it has been amply demonstrated that plants raised in other parts of the province invariably give better results. This is due principally to the fact that most of the Auckland berries are grown in a heavy clay soil, which produces excellent fruit but is not suitable for the raising of plants. A lighter soil that will not retard the root-growth of young plants is more suitable for this purpose. Strawberry-growers in the South Island almost always themselves grow the plants they require from year to year, there being no special advantage in introducing plants from other parts.

PLANTING.

Planting is best done in the autumn, sufficiently early to give the plants time to send out young fibrous roots before the cold and wet winter months stop all growth. The only exception to this is when the land to be planted is likely to be saturated with water for any appreciable length of time during the winter months, a condition which is unsuitable for strawberry-growing. When circumstances prevent

autumn planting this work is best delayed until shortly before the plants commence growth in the spring. This is most important in localities where severe frosts are experienced. When new roots have not been formed before the dormant period the freezing of the surface soil will draw the plants partially out of the ground unless very firmly and deeply planted.

Rows should be spaced 3 ft. apart where horse-drawn implements are to be used in cultivation Where hand cultivation is to be practised a distance of 2 ft. 6 in. between the rows is sufficient. In both cases the plants should be set out from 6 in. to 9 in. apart in the rows. The double-row system of planting is practised by some growers, and with fair results. This system is to have a wide and a narrow alley respectively between each alternate row, the width of the former being 3 ft. and of the latter 1 ft. 6 in. This method has the advantage of allowing a greater number of plants per acre than with the single-row system, and more than half the ground can be cultivated by horse-drawn implements. This practice cannot be recommended for stiff clay soils, however.

In preparing ground it is most important that all weeds should be buried deeply or worked out of the surface soil before planting is commenced. Sorrel and couch-grass are especially to be guarded against in this way, for if these weeds become entwined about the crown of a plant it is often impossible to remove them without causing serious damage. From 3 in. to 4 in. of this surface soil should be worked to a fine tilth, and should then be smoothed and pressed ; a horse-drawn clod-crusher serves this purpose admirably. This work must be done only when the land is reasonably dry, otherwise the horses' feet and the weight of the crusher will make the ground too firm for planting. If the ground is not pressed before planting it will be found that after the land has been tilled for a few months the frequent walking and cultivating between the rows will cause that part to sink, leaving the soil round the plants from 1 in. to 2 in. higher than the remainder of the plantation. Where this condition prevails the plant will feel the effect of the dry summer weather much more than it would if the surface of the soil was even. In small plots it is a good practice to dig in a heavy dressing of stable manure or other vegetable matter as deeply as possible when preparing the ground for planting. This assists in procuring better drainage and a warmer soil, with consequent better results.

A 14-gauge wire makes an excellent line for marking out the rows. When the wire is in position the wheel of a hand cultivator should be run along the line, and it will be found that the wire makes a sufficient indentation in the soil to be really seen. The wire can then be removed and the planting-furrow made. A Planet Jr. machine with hand-plough attached is most suitable for this purpose. In planting, the roots should be well spread. The soil requires to be firmly pressed around each plant, and the plant should be placed at sufficient depth so that the top of the crown is level with the soil surface. In soils of a very light and porous nature the crown should be slightly below the soil surface, a depression being left round the plant so that the crown will not be completely covered. For small plots the use of a hand trowel can be recommended for planting in place of the machine.

CULTIVATION.

The strawberry is a plant that requires abundant moisture during the summer and autumn months if a long cropping-period is to be maintained. With this object in view the ground should be kept in a fine state of tilth until the mulch is laid, so as to conserve the soil moisture and to give the air access to the soil round the plant-roots.

Owing to the strong-rooting habits of the plant, deep cultivation is not advisable in close proximity to the foliage, otherwise valuable feeding-roots will be destroyed. Adjacent to the plants cultivation should be maintained to a depth of from 1 in. to 1½ in., which will prevent the roots from coming too close to the soil surface, as they invariably will if not kept down by constant cultivation. When the roots are close to the surface the plants are more susceptible to acute changes of temperature and moisture, consequently this condition should be carefully guarded against. Where rows are planted at a sufficient distance apart to allow the use of a horse-drawn cultivator, the ground should be tilled to a depth of 4 in., care being taken that the implement does not come within 9 in. of the plant on either side. Where hand cultivation is practised it would be too expensive an undertaking to keep the soil tilled to this depth, therefore mulching must be relied on to conserve the soil-moisture. A suitable horse-drawn cultivator for this work is one made in the shape of the letter V, and with which the angle can be readily adjusted to suit requirements; a row of very narrow tines, each 9 in. long and not more than ½ in. wide, to be fastened at equal intervals along each side of the V.

MANURING.

Strawberry-plants respond readily to fertilizers, and in many of our most profitable gardens a payable crop could not be harvested without the application of some form of manure. The quantity and class of manure to be applied must necessarily vary considerably according to the class of soil to be treated. Many growers in the vicinity of Auckland City apply annually 3 tons of mixed fertilizers per acre. Most South Island growers do not apply more than 1½ tons of mixed fertilizers. Nitrogen should be added to the soil, but only in such quantities as will stimulate the growth of the plant without causing excessive leaf-production. An excess of nitrogen will produce an abundant leaf-growth without a proportionate fruit-production. The use of phosphatic fertilizers alone will produce an excess of fruit for the size of the plant, and will not stimulate the growth of the plant sufficiently to give the greatest production of large-size fruit. Hence a combination of phosphate and nitrogen is necessary in order to obtain maximum results; when phosphate is in excess of nitrogen a firmer fruit will be produced. In addition to nitrogen and phosphate, potash should also be applied to most soils.

Nitrate of soda can be used to advantage when the fruit is maturing, or as a spur to lagging growth early in the spring. When the growth is normal nitrate of soda should not be applied until the earliest berries have attained at least half their mature size, as this fertilizer tends to produce a too luxuriant leafage and also detrimentally affects the texture of the fruit. Three applications at fortnightly intervals are desirable. When the weather is dry nitrate of soda may be given in

liquid form. The proportion recommended is 1 oz. to 2 gallons of water, giving from 1 to 1½ pints to each plant.

When land is to be planted during the month of May it should be given a final ploughing about two weeks before planting. Where cover-crops have been grown the ploughing should be several weeks earlier. Immediately prior to this ploughing manure—either organic manure or artificial fertilizers—should be applied evenly over the entire ground-surface. Before planting, fertilizers can, in certain classes of soil, be sown in the small furrows that have been made to receive the young plants. As soon as the heavy winter rains have passed, and before the plants break into new leaf, a third application of fertilizers is desirable. With varieties that produce a second crop annually, such as Melba, fertilizers should be distributed around the plants immediately the early season crop has been harvested.

Many different classes of fertilizers are being used throughout the Dominion by strawberry-growers, and with varying degrees of success, but blood-and-bone, superphosphate, sulphate of potash, Peruvian guano, and nitrate of soda usually give the best results. The following manurial scheme must be taken only as a basis on which to work out individual programmes, for as soils vary so must the manurial programme vary if the greatest success is to be obtained. The figures given are for an area of 1 acre.

When applied.	Blood-and-bone.	Super.	Sulphate of Potash.	Guano or Nitrate of Soda.
	Cwt.	Cwt.	Cwt.	Cwt.
(1) Before planting	8	8	2	..
(2) At planting	3	3	..	..
(3) In early spring	8	8	2	..
(4) Immediately prior to mulching	..	..	..	2
(5) After early season's crop is harvested, and when an autumn crop is expected	6	6	..	..

When application No. 5 is necessary, Nos. 1 and 3 may be reduced proportionately so that the total will not be increased. In an established garden Nos. 1 to 3 inclusive should be applied together in the early spring. In certain clay soils No. 2 will cause a severe burning of the roots, and in localities where this trouble is experienced an application at the time of planting should be postponed until the first cultivation after planting.

No matter what quantity is applied, artificial fertilizers will not fully compensate for a lack of humus in the soil; therefore it is essential to success that humus be supplied in some form or other. The ploughing in of a cover-crop serves this purpose satisfactorily. Leguminous plants are to be recommended, especially blue or white lupin, which should be sown with 4 cwt. of superphosphate per acre. When stable or farmyard manure is available at a reasonable cost, however, it should be always given preference. When a heavy dressing of natural manure is given the application of nitrogenous artificials should be proportionately reduced.

The strawberry is a plant that is considered to require an acid soil, consequently lime should not be applied, nor any special treatment given to sweeten the soil, except that the ground should be kept fallow during the summer and autumn months prior to planting.

RUNNERS.

Runners are usually produced in abundance on first-year plants, and if allowed to remain the growth of the parent plant will be considerably retarded, and will yield a proportionately small quantity of fruit if they are retained for the second season. Where new plants are required a sufficient number of first-year plants should be set aside for this purpose. These plants had best be prevented from fruiting; this will more than double the number, and greatly increase the size and vigour of the runner plants. It is worthy of mention that plants produced early in the season invariably give better results when planted out than plants produced in the late summer and autumn months, as the crowns of the latter are not sufficiently matured. The cutting-off of the spring blooms stimulates the production and growth of runners early in the season. When the single-row system is in operation runners should be trained into every alternate alley, leaving every other alley free for cultivation.

MULCHING.

Oat, wheat, or barley straw will be found most satisfactory for mulching. Pine-needles and rushes are sometimes used, but are not recommended when straw is procurable. Hay, also, is sometimes used, but owing to the great number of seeds contained therein it is necessary to expose it to the weather until they have all germinated before it is distributed on the strawberry-beds. Mulches should be applied shortly after the earliest berries have set. The whole ground-surface should be covered, including under the leaves of every plant. A good mulch helps to retain the moisture in the soil and keeps the fruit clean.

HARVESTING.

In the picking and packing of strawberries for market the fruit should never be touched by hand, but rather handled by the stalk. When picking, the stalk should be pinched off between the thumb and forefinger, and not pulled until it breaks as is so often done by careless and inexperienced pickers. This practice of pinching is quick, gives an even length of stalk, and does not injure the crown of the plant. When facing the top layer of berries in a punnet the same practice of handling by the stalk should be adopted; this will be found to materially assist in avoiding bruising of the fruit. Punnet-carriers (or trays) should be sufficiently large to contain four filled punnets. This size is desirable because when the carrier is placed on uneven ground it will not readily fall over. A supply of empty punnets can be carried, telescope fashion, under the punnets that are being filled. As each punnet is filled it should be left in the field to be collected by others, care being taken that the fruit is not unduly exposed to the sun. On bright sunny days the punnets should be collected as soon after they are filled as possible. In small gardens a suitable carrier to use when collecting punnets is one constructed to carry three tiers, with space

for eight punnets on each tier. For large areas a wheel-barrow with a specially constructed body that will carry two tiers of punnets is most satisfactory. A two-wheeled handcart is to be avoided on account of the difficulty of preventing the wheels from damaging the plants.

FUNGUS DISEASES AND INSECT PESTS.

Leaf-spot (*Mycosphaerella fragariae*): A fungus disease known as strawberry leaf-spot is common on many varieties throughout New Zealand. Circular brown-coloured spots, approximately ⅛ in. in diameter, are produced on the foliage. Where the infection is severe the mature leaves may be almost completely covered by these spots, killing the tissue of the part affected and consequently preventing the foliage from functioning as it otherwise would. Periodical sprayings with bordeaux mixture at the following formula during the early summer months will satisfactorily control this disease: Sulphate of copper (bluestone), 4 lb.; quicklime, 4 lb.; water, 40 gallons. The Melba variety is almost immune from attack by leaf-spot, whereas Marguerite is very susceptible.

Grey mould (*Botrytis* sp.): This disease causes considerable decay of partially matured fruit on the plants, and in certain seasons heavy losses of fruit between picking and marketing. It first appears as a brown discoloration, which spreads rapidly over the whole berry, causing decay. The disease thrives best in damp still air conditions, and is found most destructive to fruit on plants growing in poorly drained soils, especially in weedy plantations and during heavy rainfall. Fruit which has been picked damp or held under close atmospheric conditions is most likely to develop decay before marketing. All berries showing signs of grey mould should be discarded at picking-time, so as not to contaminate sound fruit in the same container. Diseased fruits should be destroyed, as they rapidly become covered with the fine grey powdery growth of the causal fungus which is largely responsible for the spread of the disease.

Strawberry-mildew (*Sphaerothea humuli*): This is sometimes met with in New Zealand. Occasional applications of lime-sulphur at a strength of 1 to 100 will guard against the disease.

Red mite (*Bryobia pratensis*) and red spider (*Tetranychus telarius*): These pests are frequently met with in strawberry-gardens, particularly on plants allowed to remain for the second-season crop. The insects are dull-red in colour, and the former are minutely small, being barely discernable with the naked eye. Being sucking insects, they can do considerable damage to the foliage if not kept in check. Control measures consist of spraying with lime-sulphur at 1–100 plus Black Leaf 40 at 1–800, whenever the pest becomes troublesome. As these insects live principally on the underside of the leaves it is important that the spray should be directed upwards. This can be done by the use of a nozzle that sprays at an angle of 45 degrees from the rod.

Green aphis (*Myzus* sp.): This sucking insect is not uncommon in strawberry plantations throughout the Dominion. It is usually most troublesome on the young leaves as they emerge from the crown, and on the underside of the foliage. A thorough spraying with insecticidal sprays, such as lime-sulphur or Black Leaf 40, will effectively control this pest.

Large brown beetle (*Odontria zealandica*): In certain parts of New Zealand more damage is done to strawberry-plants by this insect than by all other insect pests and fungus diseases combined. The beetle is most active during the dusk of evening, and where sufficient numbers are present they seriously damage the foliage by chewing the young and tender leaves. In addition to the damage that may be done to the foliage, this pest causes far more extensive injury to the plant when in the larval state. The beetles deposit their eggs round the crown of the plant, and on hatching the grubs bore their way into the ground, where they live on the roots, frequently destroying every root that the plant possesses. No satisfactory means of controlling brown beetle, either in the larval or beetle state, has so far been found. Plants that are grown for one season only are not seriously troubled by the larvæ, consequently where the pest is very troublesome replanting every season is the only way of combating it.

SPRAYING.

A barrel of sufficient size to contain 25 gallons of spray mixture, fitted on a wheelbarrow, with a well-constructed light pump attached, will be found suitable for spraying operations in strawberry-gardens. A horse-drawn spray outfit cannot be recommended except in areas of some 10 acres and upwards.

The writer is indebted to Mr. W. H. Rice, Orchard Instructor, Auckland, for information on various points, more particularly with reference to diseases and insect pests; also to Mr. W. K. Dallas, Orchard Instructor, Dunedin, in connection with varieties grown in Otago, &c.

Parasitic Control of Woolly Aphis.—Addressing the recent Fruitgrowers' Conference at Wellington, Mr. D. Miller, of the Cawthron Institute, stated that woolly aphis had been on the increase during the past two seasons; such fluctuations were to be expected. In order that control by the parasite *Aphelinus mali* might be effectively maintained from year to year it would be necessary to keep artificially reared colonies on hand for distribution to localities where there was a temporary increase of the aphis. This would require the services of an assistant giving his whole time to the work.

Wheat Research.—At the July meeting of the Research Council the Chairman stated that the Cereal Laboratory building in Christchurch is being prepared with such standard fittings as will be necessary. The procuring of the technical apparatus and equipment will be left until the Cereal Chemist is appointed. Advice concerning recommendations for this appointment is at present being awaited from the English selection committee. At present an investigation into oven efficiency is under way, the details of the work being carried out by Dr. Barnett. This investigation is for the purpose of providing such information to bakers as will help them to secure reduction of their fuel costs and allow the attainment of a greater efficiency from their ovens.

FROST-PREVENTION FOR ORCHARDS.

(Concluded.)

W. R. Lloyd Williams, F.H.A.S., Orchard Instructor, Alexandra.

IV.—ORCHARD-HEATING.

It is on record that orchard heating has been practised from very early days, Pliny having recommended the heating and smudging which was used as frost protection by the Romans. In the sixteenth and eighteenth centuries these methods were in vogue in the French and German vineyards and orchards, and it was also practised with considerable skill by the Indians of Peru, no doubt inherited from the pre-Spanish civilization. Records of this early work show that some of the methods followed were not as crude as one might suppose; in fact, some of our modern practices are less scientific in their adaptations than the earliest attempts on record. A variety of fuels have been used. In the latter part of last century the French vine-growers and also the citrus-fruit growers of California and Florida were beginning to use heavy oil as fuel. At the same time the deciduous-fruit growers of the north-western regions of North America also were working on similar lines. (*Better Fruit*, March, 1927.)

Although other methods have been suggested, the experience so far in countries that undertake the protection of their orchards from frost is that the only safe and practical means of obtaining complete protection is by actual heating of the air by means of a *large number of small heaters* distributed over the area to be protected. In this manner all the air under the "ceiling," previously referred to, is warmed until it is above the danger-point.

Fuel.

The main sources of fuel available are wood, coal, and oil. Wood hardly enters into the picture here, as it is such a scarce commodity in Central Otago. Coal is used in its ordinary condition and also in the form of briquets, but oil is by far the most used in America.

COAL.

Coal has been used in Hawke's Bay with successful results, and a short account of its use is essential. I am indebted to Mr. N. J. Adamson, Orchard Instructor, Hastings, for the following description of the methods employed by Mr. Ralph Paynter in the use of coal in frost-fighting:—

A number of orchardists in Hawke's Bay have attempted to protect themselves against late frosts for quite a considerable time, and they claim that successful "saves" have been made. From observations I have made this (1926-27) season I am satisfied that good results have been obtained by their method of orchard heating. Severe late frosts, sufficient to injure the fruit crop, are not an annual occurrence, and firing has not been resorted to very often, although everything has been in readiness in case of emergency. Mr. Ralph Paynter tells me he has not had to fire since 1918. This year he fired once only.

The method of frost-fighting is by orchard heating, the fuel used being Newcastle coal. Benzine-tins are used for stoves, and are inexpensive and quite efficient. A hole is cut out of one side near the bottom, through which the torch

for lighting may be applied. The fire is set by laying a few dry sticks in a burning position over the opening, and then the tin is nearly filled with lumps of coal. To keep the fuel dry the tins are provided with a cover. These may be made out of benzine-tins also one tin providing three covers if cut correctly.

The method of lighting is by throwing in a piece of tow, one of a number previously soaked in kerosene. These may be carried in a bucket, and lit by means of a torch made from a piece of pumice on a wire, the pumice being previously soaked in kerosene. Several of these torches should be on hand. Lighting up may be done very quickly by this method. Two men could light up 7 acres in less than half an hour.

A ton of coal is sufficient for two to five fires. Fires are placed one to every two trees, and on outside rows one to each tree. This will provide for a seven- to eight-degree frost. This however may be placed at every tree. This would provide for about ten degrees of frost. Alternate fires could be lit for a warm. It may be necessary on occasions to add a little more fuel to keep the fires going for a longer period.

No alarm thermometers are being used. A good thermometer is placed on the orchard a few feet from the ground. A number of growers use a maximum and minimum registering thermometer, usually two placed in separate positions. The thermometer is watched closely on a night when there is a tendency towards a severe frost. A certain amount of frost injury occurred this season on the lower-lying localities, but the men who fired received no injury.

It has been freely stated that the cost of heating with Newcastle coal is a great deal less than with oil. For a ten-degree (Farr) frost which we occasionally have to guard against at least one hundred tins per acre would be necessary. For an average frost probably eighty might be lit for which 1½ cwt. of coal at 34s. or 4l. per ton (landed at Alexandra) would be necessary, equalling £2 12s. per acre per firing, compared with £1 10s. for oil. Where the coal fires is through the whole of the 1½ cwt. being consumed at each firing, owing to it being of little value after once being lit, whereas the oil can be extinguished at any time and the rest of it will be quite good. For a long burn probably coal would be a little cheaper but this advantage can be easily discounted by the extra labour of filling, refilling, and lighting. Coal is also more bulky to handle.

OIL.

Oil is undoubtedly the most popular fuel in America—the home of orchard heating. In California orchard-heating oil or Diesel oil, varying in density from 24° to 36° Baumé is generally used. That used in our Central Otago experiments, and which proved quite suitable, was the Shell Company of New Zealand's Tarakan oil, a product of British Borneo, from which only the lighter fractions—benzine and kerosenes—have been extracted. Its specific gravity is 0·841, equal to 237 gallons per ton weight. The quotation for this oil is £6 3s. per ton delivered in 42-gallon drums on rail Dunedin, railage to Alexandra £2 3s. 6d. per ton, freight on empty drums for filling 1½d. per drum; making a total cost landed at Alexandra of 8·62d. per gallon, or, say, 9d. per gallon in the orchard. The rate of consumption is a little under 1 quart per hour. An average of three firings of two hours each per annum made an average of six hours burning per annum. It has previously been shown that during the last twelve years the greatest number of frost firings in any one year would have been six; oil should therefore be on hand at the beginning of the season for at least six heatings.

Equipment.

FIREPOTS.

Many types of heaters, from the elaborate high-stack smokeless to the simple lard-pail, have been evolved, the former mostly for citrus-groves. As we are concerned only with the protection of deciduous fruits, and as the cheaper types of heaters have been found effective here and alsewhere, I will confine my remarks to those suited for this purpose. What is known in America as the lard-pail heater is almost universally used in deciduous orchards. An illustration is shown in Fig. 3 (left). On the right of the same figure is illustrated a 5-quart pot, lid, and spider made by Farra Bros., Dunedin, which has proved suitable for the purpose. The dimensions are—diameter, at bottom 7½ in., at top 9¼ in.; height, 8½ in. The specifications are—bodies, 26-gauge black steel; top, false-wired; bottoms, double-seamed; spiders, 18-gauge black steel with welded arms; lids, 26-gauge black steel with ¾ in. flanged rim. The price is £9 per 100 sets f.o.r. Dunedin, with a discount of 7½ per cent. off quantities of 1,000 or over. The cost per pot landed in Alexandra would be—in 100 lots 1s. 10¾d., and in 1,000 lots 1s. 9d. The pots, spiders, and lids should be cleaned, oiled, and carefully stored in a dry shed after danger of frosts is over, leaky pots or bent lids and spiders being put on one side for repairs during the winter months.

DRUMS.

The best method at present of obtaining the oil and storing it is in 42-gallon steel drums, which can be supplied by the Shell Company of New Zealand Limited at 5s. each. So as to enable one man to handle them expeditiously when filled it is advisable to store them on long frames raised from the ground. A large oil-tap will be necessary for running off the oil.

THERMOMETERS.

A sufficient number of accurate minimum thermometers is essential; much oil can be unnecessarily burned or, on the other hand, much fruit lost by not burning enough through being misled by insufficient or inaccurate thermometers. The number required will depend on the nature of the orchard. If the ground is fairly level and the temperatures even on the plot to be heated probably two would be sufficient for 2 acres, three for 4 acres, and five for 10 acres. In addition, at least one is necessary well outside the heated area as a check. Before the time for orchard heating commences growers are advised to take temperatures at various points in order to find out the coldest spots and also to co-ordinate the temperatures of the check thermometers with those in the heated area. The following advice from Dr. Kidson's "Protection of Orchards against Frost" should be carefully read and followed:—

> The best type of thermometer to use is the horizontal alcohol minimum thermometer. The existing temperature can be ascertained at any time by reading the end of the column of alcohol, and at the same time the end of the glass index nearest the end of the column shows the lowest temperature reached since the thermometer was last set. It may be necessary to allow the bulb of the thermometer to dip slightly to reduce the friction of the index, which has to be carried back by the surface film of the alcohol. The inclination should not be

more than necessary, however, otherwise a strong wind may shake the index down towards the bulb. The thermometer should be reset each day during the frost period by tilting up the bulb until the index slides down into contact with the surface. It is desirable to take the thermometers in during the hotter part of the day and replace them in the evening. While inside, the thermometers should be kept vertical with the bulb downwards. These precautions are necessary since the spirit is liable to distil into the upper portions of the stem and the thermometer, consequently, to read too low.

Occasionally the spirit column will be broken by bubbles, or the index will break through the surface. The column should then be rejoined by holding the thermometer in the hand with the bulb downwards and tapping the hand on the knee or some soft object. If the thermometer is in a wooden frame, the latter may be tapped gently on a pad until the spirit has all joined up with the main column.

The accuracy of thermometers should be tested when first received and at intervals afterwards. Many are inaccurate. Advice should be taken from a local official as to suitable makes. If there is an expert in the district he may undertake the testing, but if not, it can be done by checking the freezing-point. For this purpose a vessel containing a mixture of chipped ice or snow and water may be used. The mixture should be stirred and the thermometer left in it for several minutes. When read, only sufficient of the stem should be withdrawn to allow of a reading being made, and the reading should be 32° F.

Thermometers should be read quickly, and the light used should not throw out much heat, otherwise the instrument will be warmed and the temperature be forced up during the process. An electric torch is by far the most satisfactory light. The shelter should face south, so as to protect the thermometer from the sun. A thermometer should not be placed near a heater or the temperature recorded will be above the average in the orchard.

If the lines and numbers indicating the degrees become faint they can be freshened up with a little black paint, rubbing off the surplus with soft paper. Rubbing the lead of an ordinary black lead pencil along the stem will also give the desired result.

Two types of thermometers were used in the experiments; one by Negretti and Zambra (British make), costing here £2, and shown in Fig. 11 (bottom right-hand corner); the other a Tycos (American), shown on thermometer-stand in Fig. 6, and costing about 17s. 6d. landed here. Standard minimum thermometers by Pastorelli and Rankin, Ltd., England, are being supplied by the New Zealand Fruitgrowers' Federation, Ltd., to growers at £1 10s. each, with an additional charge of 3s. 6d. for testing.

THERMOMETER SHELTERS.

Standard temperatures are taken at a height of 4 ft. 6 in. to 5 ft. from the ground. Thermometers, if fully exposed to the sky at night, radiate heat and become colder than the air, consequently they register a lower temperature than they should; they are therefore placed under a shelter. A useful shelter is shown in Fig. 6. It consists of a hard-wood post, 7 ft. by 2 in. by 2 in. (pointed at one end), to which a board 1 ft. 3 in. long by 9 in. deep is screwed a few inches from the top. On the top of this board is a hinged lid of the same size, bevelled on the edge so that it may hang down like a roof as a protection to the thermometer, which is hung on two screws as high up on the first board as possible. The screw for the bulb end should be very slightly lower than the other, so as to give the thermometer a very slight tilt. The lid can be lifted up, as seen in Fig. 6, for easy reading of the temperature. The post should be sunk in the ground to a sufficient depth to allow for the thermometer being the correct height (4 ft. 6 in.) above

the ground. Most growers have sufficient timber with which to make shelters, but if not they should not cost more than 5s. each.

LIGHTING-TORCHES AND FUEL.

A satisfactory lighting-torch is shown in Fig. 4 (left). The container holds 2 quarts, is 9 in. long by 4⅛ in. diameter, is made of 26-gauge tinplate, with a handle and a welded spout about half as long again as the container. The spout is fitted at the point with fine-mesh brass gauze, and similar gauze is soldered inside the base of the spout. Under no circumstance should a torch be used with this gauze lacking or defective, for it acts as in a miner's lamp and prevents disastrous explosions in the container. The price f.o.r. Dunedin is 9s. 6d. The fuel used is half kerosene and half benzine, with a slight preponderance of the latter. The torch is tipped up until the fuel runs out from the spout, and is lit with a match. Liquid fire is then dropped into the firepots. When new these are more difficult to light, and in this case a ring of fire should be spread round the edge of the oil. After the first using they are quite easy to light, the soot acting as a wick. In running between pots the torch will remain alight, even if tilted up to prevent dropping the fuel on the ground. An extra supply of lighting-fuel should be prepared and placed in an airtight container; torches should be filled in daylight or in the light of an electric torch.

WHEELED SLEDGE AND CANS.

A low cart or wheeled sledge—which many growers have—is convenient for carting the oil-drums to the orchard for filling the pots. Large watering-cans or a hose may be necessary for transferring the oil from the drums to the pots.

ALARM.

An alarm is essential, especially in a district where there is no local meteorological forecaster of the weather. Without elaborating further on its necessity I would refer readers to Mr. Hinton's experience on 14th November as given on page 397 of the *Journal* for June. A grower has sufficient work in the daytime without having to be continually on watch at night, for there is nothing more wearying after a day's work than night watching. The alarm used in the experiments (Fig. 6), a Tycos, was quite satisfactory, and is the only one with which I am acquainted. It is designed to give an alarm by ringing an electric bell when the temperature surrounding the thermometer has fallen to a certain point. These instruments may be obtained to ring at any temperature, but from our experiments last spring I would suggest, for safety, one ringing at 32° F. The thermometer, which is already protected, is placed on a post in the coldest location (previously ascertained); insulated wires connect it with the box containing the batteries, bell, and relay placed in the bedroom. The copper wires should be not less than No. 18 B. & S. for a distance up to 1,400 ft., and for a greater distance No. 14 B. & S. The wires should be fixed on poles overhead and not allowed to trail on the ground, and for convenience the insulation of each should be a different colour.

The thermometer consists of a positive-acting mercury-filled glass tube with a fine platinum wire permanently fused into the bore of the tube at the temperature-point at which it is desired the alarm should ring. A second wire, touching the mercury at a spot below the other, completes a circuit which is broken the instant the mercury falls below the alarm-point, and causes the alarm to ring in the house. It should be carefully tested to see that it rings at the temperature at which it is registered, and the batteries should be replaced annually. The height at which the alarm thermometer should be placed on the post can only be determined by actual experiment. If not convenient to place it in the coldest part of the orchard, temperatures must be taken there and at the point at which the alarm thermometer is to be placed. For example, if when the temperature in the coldest part of the orchard at 4 ft. 6 in. above the ground is 32° F. that at the alarm thermometer at the same height is only 34°, the alarm would not ring until the temperature in the orchard was 30° F., which might be disastrous. The earlier remarks on temperature inversion indicated that the temperature rises from the ground up; therefore, in the present instance the alarm thermometer should be lowered until the temperature there and in the orchard coincides. The cost of these alarms is £8 10s. complete with batteries, wiring, and relay.

A simple and cheap alarm sent to me by Mr. R. G. Hamilton, Orchard Instructor, Auckland, is being used successfully by a tomato-grower in that district, and will receive testing and further investigation next spring. It consists of a flat horizontal arm composed of brass, on the top of which is vulcanite. Owing to the different actions of brass and vulcanite to cold, the increasing cold causes the arm to lift until it reaches a platinum-tipped brass screw, the circuit is closed, and a bell connected by wires and three dry cells rings in the bedroom. Alteration of the adjustable screw allows of the contact being made at whatever temperature it is desired the alarm should ring. Full working drawings and specifications are in my hands. The cost of the instrument with bell and 100 yards of bell wire, but excluding batteries, is about £2.

Heating Operations.

WHEN TO PUT POTS IN THE ORCHARD.

This must be determined by the season—that is, according to the time the apricot blossoming commences. From notes taken from Mr. Bringans's diary for the years 1919 to 1927 it would appear as if the earliest at which the apricot commences to throw out its first few blossoms in this locality is during the last few days of August, and blooming usually lasts about a fortnight. Sometimes it is considerably later. Probably the last week in August or the first week in September would be the average time for the district, according to the season, although it is not anticipated, except under very exceptional circumstances, that the pots would need to be lit before the middle of September. Each grower would be wise to keep an annual record of the flowering-periods of the different fruits.

NUMBER OF POTS PER ACRE AND DISTRIBUTION.

It is impossible to advise, after only one season's experience with only a single acre, as to how many pots are required per acre or even

their exact location. However, I would not like to endeavour to protect 1 acre without having 120 pots distributed over the area, although probably not more than 100 would ever be lit at one time, and often less. Allowing the same distances apart between the pots, this would be approximately equivalent to 100 pots per acre for 2 acres, 86 pots per acre for 5 acres, and 78 pots per acre for 10 acres, providing the blocks were approximately square. The shape of the area to be protected—whether long and narrow or square—will cause some variation in the numbers and distribution. With the increase in the size of the protected area it is quite reasonable to assume that owing to the accumulated heat of such a larger area, if compact, the pots per acre might be decreased. The arrangement of the pots should be something on the lines discussed in the earlier part of this article dealing with the experiments, and shown in Fig. 10. Where the trees are planted 18 ft. apart on the square, I would suggest as a basis that the pots in the outside row on the east should be 9 ft. apart, and on the south and north 18 ft. On the north, east, and south sides place a row 18 ft. inside the outer one and 18 ft. between the pots in the rows. In the remainder of the area allow 27 ft. apart between the rows of pots and between the pots in the rows. As shown in Fig. 10, the pots should be zigzagged so as to spread out the heat as much as possible. The 27 ft. distances will occasionally bring the pots where the trees stand, but the heaters can be shifted slightly one way or the other to come between the trees in the rows. For the purpose of driving down the rows with the oil for filling and refilling it is wise to keep the rows one way well defined (the zigzagging being only one way) and the distances between pots as multiples of the distances between the trees. Where there is any difficulty in working out the number of pots required or their distribution I would be pleased to afford orchardists any assistance required. It should be pointed out that more pots are placed on the eastern side for two purposes: in the event of a very bad frost coming from any of the other directions every alternate pot from the east can, if necessary, be transferred to the danger-zone, and again they are an advantage if required to act as a smoke-screen against the rising sun.

FILLING POTS.

As soon as the pots are put out in the orchard they should be filled to within an inch of the top with oil. A convenient method would be to cart one or two drums at a time on the wheeled sledge. To the tap in the drum might be affixed a rubber hose a few feet long to run the oil direct into the pot, or it may be run into large watering-cans and put into the pots with them. Two men will be much handier than one—one at the tap and the other with the hose or cans. The spiders and lids should be put on immediately after filling. In the event of a firing the pots should be refilled before the following night in case of another frost.

WHEN AND HOW TO LIGHT.

When once the pots are put out in the orchard the alarm should be switched on every night until they are again stored in the shed.

As soon as the alarm rings cut if off, and get to the thermometers at once and watch their movements. If there is a steady fall to the danger-point, light up immediately. If, on the other hand, the temperature is wavering it is better to wait awhile until there is a clear indication of the direction in which the temperature is working. It was found last season that the colder the night the nearer to sunrise was the lowest temperature recorded; if a heavy frost occurred the coldest point would be between dawn and sunrise. In the event of the temperature rising and it being decided to return to bed, be sure the alarm is switched on again in case of a drop in the temperature towards dawn, for undoubtedly the most dangerous time is from just before dawn until sunrise.

When commencing to fire up, light for a start each alternate pot throughout the area, commencing on the side from which the air-drift is coming, probably the east and south sides. After deciding to light no time should be wasted; with an assistant taking off the lids one should be able to light an acre in five or six minutes. Keep a watch on the thermometers, and if the pots already lit do not hold the temperature, light a few more here and there where it is thought advisable. On the other hand, if the temperature is rising above the safety-zone extinguish some by replacing the lids; apart from wasting oil it is not wise to overheat. Just endeavour to keep on the safe side, using the Californian chart of dangerous temperatures (July *Journal*, page 25) as a guide. Keep a continuous watch on the pots in case the spiders need clearing of soot, and see that those lighted do not go out, as an odd one may do. As soon as the temperature outside the heated area has risen above the danger-point it will be safe to extinguish the fires by simply replacing the lids, commencing on the west side and working towards the east. If the frost has been a severe one it may be wise at sunrise to light additional fires on the eastern side with the spiders off in order to create a smoke smudge against the rising sun, as shown in Fig. 9.

WHEN TO RE-STORE EQUIPMENT.

It is difficult to advise on this point, for, as was shown earlier (June *Journal*, page 401) an unexpected frost occurred on 8th December last, contrary to usual experience. Judging from past records, early December appears to be usually a safe time for putting away all gear for the season.

Costs of Orchard-heating for Central Otago.

These estimates of costs must of necessity be crude and be considered as approximate only, and much will depend on the man and the orchard. Depreciation on equipment is shown at 10 per cent., and therefore the 3 per cent. interest charged on initial cost is equivalent to 6 per cent. on the average capital invested. Table 11 gives an estimate of the initial costs of heating equipment, fuel, &c., for 1-, 2-, 5-, and 10-acre orchards; sufficient fuel is allowed for the estimated maximum of six full burnings of two hours each for the year. Table 12 shows the overhead charges which must be allowed for annually, whether the pots are used or not. Table 13 presents the annual running-costs based on the average of six hours burning per annum. Table 14 shows the total annual average costs.

Table 11.—Estimated Initial Cost of Heating Equipment for 1, 2, 5, and 10 Acres of Deciduous Fruits.

Items.		1 Acre.		2 Acres.		5 Acres.		10 Acres.	
		Quantity or Number required.	Cost.	Quantity or Number required.	Cost.	Quantity or Number required.	Cost.	Quantity or Number required.	Cost.
			£ s. d.		£ s. d.		£ s. d.		£ s. d.
Heaters, at 1s. 9d.	No.	120	10 10 0	200	17 10 0	430	37 12 6	780	68 5 0
Oil (six heatings, 3 gallons per pot, at 9d. per gallon)	Gall.	360	13 10 0	600	22 10 0	1,290	48 7 6	2,340	87 15 0
42-gallon drums, at 5s.	No.	9	2 5 0	15	3 15 0	31	7 15 0	56	14 0 0
Wheeled sledge, cans, and fittings	..	..	5 0 0	..	5 0 0	..	5 0 0	..	10 0 0
Thermometers, at £1 13s. 6d.	No.	3	5 0 6	3	5 0 6	4	6 14 0	6	10 1 0
Thermometer-shelters, at 5s.	No.	3	0 15 0	3	0 15 0	4	1 0 0	6	1 10 0
Torches, at 10s.	No.	1	0 10 0	1	0 10 0	2	1 0 0	3	1 10 0
Lighting-fluid, at 2s. 6d.	Gall.	1	0 2 6	2	0 5 0	4	0 10 0	8	1 0 0
Alarm, complete	No.	1	8 10 0	1	8 10 0	1	8 10 0	1	8 10 0
Initial cost		..	46 3 0	..	63 15 6	..	116 9 0	..	202 11 0
Initial cost per acre		..	46 3 0	..	31 17 9	..	23 5 10	..	20 5 1

Table 12.—Estimated Annual Overhead Costs.

Items.	1 Acre: Cost.	2 Acres: Cost.	5 Acres: Cost.	10 Acres: Cost.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Depreciation: 10 per cent. on initial cost of heaters, drums, sledge, &c., thermometers, thermometer-shelters, torches, alarm, and lighting-fluid	3 5 4	4 2 7	6 16 2	11 9 7
Interest, 3 per cent. on above	0 19 7	1 4 9	2 0 10	3 8 10
Interest on oil at 6 per cent.	0 16 3	1 7 0	2 18 1	5 5 4
Labour: First putting out of pots, filling, re-storing, and repairs	1 0 0	1 15 0	3 15 0	7 0 0
Annual overhead cost	6 1 2	8 9 4	15 10 1	27 3 9
Annual overhead cost per acre	6 1 2	4 4 8	3 2 0	2 14 5

Table 13.—Estimated Annual Average Running Costs.

Items.		1 Acre.		2 Acres.		5 Acres.		10 Acres.	
		Quantity or Number required.	Cost.	Quantity or Number required.	Cost.	Quantity or Number required.	Cost.	Quantity or Number required.	Cost.
			£ s. d.		£ s. d.		£ s. d.		£ s. d.
Oil for six hours, 1½ gallons per pot, at 9d. per gallon	Gall.	180	6 15 0	300	11 5 0	645	24 3 9	1,170	43 17 6
Lighting-fluid, at 2s. 6d. per gallon ..	Gall.	¾	0 2 0	1½	0 3 9	3	0 7 6	6	0 15 0
Batteries for alarm, at 2s. 6d. each ..	No.	3	0 7 6	3	0 7 6	3	0 7 6	3	0 7 6
Labour, lighting, refilling, &c.		..	1 15 0	..	3 10 0	..	7 10 0	..	14 0 0
Annual running cost		..	8 19 6	..	15 6 3	..	32 8 9	..	59 0 0
Annual running-cost per acre		..	8 19 6	..	7 13 2	..	6 9 9	..	5 18 0

Table 14.—Estimated Total Average Annual Costs.

Items.	1 Acre: Cost.	2 Acres: Cost.	5 Acres: Cost.	10 Acres: Cost.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Annual overhead costs ..	6 1 2	8 9 4	15 10 1	27 3 9
Annual running-costs ..	8 19 6	15 6 3	32 8 9	59 0 0
Total costs ..	15 0 8	23 15 7	47 18 10	86 3 9
Total cost per acre ..	15 0 8	11 17 9	9 11 9	8 12 5

V.—PROTECTION OF TOMATO CROPS FROM FROST.

Although the foregoing experiments and the advice given in this article were primarily intended for the assistance of the fruitgrower, much of it is applicable to the protection of tomato and other crops which bulk largely in the economy of this district.

Cutting back Frosted Tomato-plants.—Acting under my advice, Mr. W. H. Hinton, Earnscleugh, after a heavy frosting of his tomato-plants last spring immediately cut them off close to the ground. The contrast between these plants and some less frosted and left uncut was most remarkable ; the former made a great recovery and carried an enormous crop, while the untreated ones never properly caught up and only carried a light crop.

Autumn Experiments.—The alarm and several of the thermometers previously referred to were set up in the orchard of Hinton's Orchards Ltd., at Earnscleugh, at a late period last season, to experiment in the protection of the tomato crop against autumn frosts. Mr. W. H. Hinton's report is interesting and may be quoted as follows :—

> The tomato patch protected was divided into bays by rows of fruit-trees, the whole area being a little under 1 acre and containing 9,000 plants. Thermometers numbered 1, 2, 3, and 4 were placed one at each corner. No. 1 was on the highest ground and under the willows; this thermometer on a cold night registered four to five degrees higher than No. 3. The alarm thermometer (Fig. 6) was situated between Nos. 3 and 4. All four thermometers and the alarm thermometer were 1 ft. from the ground. On the morning of 5th April, 1928, the alarm rang at 3.45 a.m. We waited for three or four degrees of frost before lighting up, but instead of dropping the temperature rose four degrees and then dropped ; the alarm rang again at 5.30 a.m., and the temperature gradually dropped until sun-up. At 6.10 a.m. the readings were—No. 1, 34° ; No. 2, 31° ; No. 3, 30° ; and No. 4, 31·5° F. With half an hour to go before sunrise, and the temperature still dropping, we decided to light all pots which showed a coating of hoarfrost on the lids—thirty in number—in the vicinity of No. 3 thermometer. Although we did not raise the temperature of the latter, which could hardly be expected with only thirty pots, we certainly held it, as shown by the following readings at 6.45 a.m., when the pots were extinguished : No. 1 had dropped one and a half degrees since 6.10 a.m. ; No. 2 two degrees ; No. 3 was the same (30° F.) ; and No. 4 had dropped two degrees. This being our first experiment with autumn frost-fighting, we could only guess how much frost old hardened plants could stand. In the lighted area the leaves of the plants were soft when the fires were put out, but in other parts, where the temperature dropped below freezing-point, a fair proportion of the top leaves were stiff. Soon after this the prospects were for very heavy frosts, and we decided to pick the balance of the crop and the pots were put away.

VI.—ADDITIONAL EXPERIMENTS.

An attempt was made last autumn to co-ordinate the standard temperatures in the Stevenson screen with those registered by our field thermometers under the hooded shelters, and also with the ground temperatures. The arrangement of the apparatus is shown in Fig. 15.

The temperature under our field shelters appears to be anywhere from half a degree to five degrees lower than in the Stevenson screen, and the grass temperature apparently runs from one and a half to six degrees below that under the field shelter. However, the variations in the lower registers—32° F. and lower—appear to be more consistent, the difference being from three to five degrees and mostly about four degrees. It is trusted that more data will become available in this connection when the climatological station is established here.

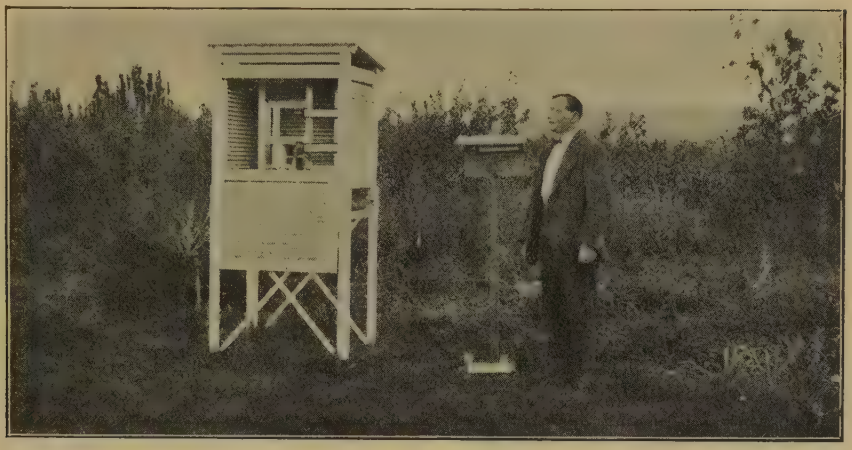

FIG. 15. STANDARD STEVENSON SCREEN (AUSTRALIAN PATTERN), FIELD HOODED SHELTER WITH THERMOMETER, AND UNCOVERED THERMOMETER.

On left, the Stevenson screen with door opened downwards. On right, field hooded shelter with minimum thermometer. At foot of shelter another minimum thermometer, uncovered and supported 2 in. from the ground. The screen is open directly to the south; the Old Woman Rock (N.N.W.) can be seen on the highest point immediately on left of screen, while the writer is looking directly at the Old Man Rock (S.W.).

[*Photo by F. Varney.*

The Government has decided to make another grant for the continuance of the experiments during the coming season, for although we certainly have behind us the experience of years of orchard heating in America we are still in the early stage so far as local information is concerned. It has been decided to arrange the next experiments on a larger scale by combining forces with Mr. Bringans. With the pots owned by him and the Department of Agriculture, and the combined use of the oil, it is hoped in the event of frost to protect an area of 4 or 5 acres.

"PULPY-KIDNEY" DISEASE OF LAMBS: A NEW THEORY.

At the annual conference of the New Zealand Veterinary Association held in Wellington last month Mr. D. A. Gill, M.R.C.V.S., of the Wallaceville Laboratory, advanced a new theory regarding the "pulpy-kidney" disease which causes considerable mortality among young fat lambs. Briefly, he stated that while still regarding the primary cause as nutritional — the overfat lambs being exposed to the attacks of intestinal bacteria—he had formed the opinion that certain bacteria, normally present in the large intestine, might be responsible for setting up the toxic condition which caused death. He had found these bacteria in the small intestine of affected lambs, and when located there they would be in a good position to exert adverse chemical changes on the passing food, and the products resulting from those changes would be far more easily absorbed than from the large intestine. Assuming that such products were of a particular kind—and this was very likely the case — then all the post-mortem lesions usually found in this disease, and all such anti-mortem symptoms as were sometimes observed, could be readily accounted for. Mr. Gill's theory was well received by the conference, and, while some friendly criticism was offered, the view was expressed that it was well worth continued investigation.

ORCHARD IRRIGATION BY MOBILE PIPE SYSTEM.

PROMISING EXPERIENCE IN MARLBOROUGH.

M. DAVEY, Orchard Instructor, Blenheim.

DURING the greater part of the main season of 1927–28 the rainfall in Marlborough—so far, at least, as the Marlborough Plain was concerned—was very deficient. The rain-gauge at Spring Creek registered as follows: October, 0·68 in.; November, 3·57 in.; December, 0·73 in.; January, 0·02 in.; February, 1·73 in.; March, 1·92 in.—making a total of 8·65 in. for the six months. This meant that fruit-development with regard to colour, size, and in some varieties maturity, was much retarded, especially when one considers that December, January, and February are the three principal months affecting fruit in these respects. In addition, hot drying winds from the north-west were persistent, causing abnormal transpiration of the foliage. A stratum of coarse shingle underlying many of these orchards, at varying depths, disconnects capillarity after the water has receded below permanent winter levels, leaving the cultivator entirely dependent on the conservation of moisture contained in the soil above the shingle. The conditions, in fact, were such as to place fruitgrowers in certain orchards in a precarious position.

Under the limited rainfall and drying conditions mentioned, ways and means to avoid a complete failure of the fruit crop and serious debilitation of the trees had to be actively considered, with the result that Messrs. Ivory Bros. imported from South Australia a small surface-irrigating plant of a method known as Pope's irrigation system.

Briefly, the system consists of a water-main which can be easily transferred and laid down between the trees on the surface of the ground, and which delivers a supply of water over such ground by distribution from single sprinklers placed 18 ft. apart on the top of the pipes. The maker's claims for this system are as follows: (1) It ensures perfectly even distribution of water for the full length of the line; (2) no grading of the soil is necessary; (3) hillside may be irrigated as easily as the flat; (4) a great comparative saving of water is effected; (5) night watering can be carried out; (6) a great saving of labour is effected, little or no attention being required between the times of shifting over from one area to another; (7) working at 30 lb. pressure, 300 gallons per hour passes through each sprinkler, equivalent to 4 in. of rain in two hours.

These claims seem to be borne out in practice so far as local experience during the past season has shown, but quantities of water delivered have not been checked. The plant was installed during the latter end of February, and applied to a block of Cox's Orange apple-trees when a pronounced dropping of the foliage on this and other varieties had set in. Development of the fruit was also at a standstill, and the outlook was decidedly serious. Surface cultivation had been consistently undertaken prior to this time, but the resources in this direction were evidently exhausted.

The writer had an opportunity of inspecting this block of Cox's Orange nine days after irrigation had been commenced, the moisture so obtained having been conserved by cultivation as soon as the wet ground would permit. The beneficial results then showing were most pronounced, the foliage having assumed a flourishing appearance, while the fruit had evidently quite picked up in development, as evidenced by an improved colour and tightness of the skin. In this instance the pipe-line was shifted after every two hours' delivery of water, this being necessary owing to the large area suffering from drought conditions and the belated application of moisture. With more time available it would undoubtedly be prudent to start irrigation on these lines in January, and so avoid extremes with consequent detriment to the trees and fruit.

In another case, owing to lack of opportunity, only 50 per cent. of a block of Jonathan apples received treatment. On examination during the month of June the development of fruit-buds for next season was undoubtedly superior on the irrigated block compared with that of the non-irrigated trees.

The matter may be summarized as follows :—

(1) For the class of land under consideration—light sandy to good river silts—the system described has great advantages, the trees deriving maximum benefit from a minimum amount of water, while serious leakage through extremely open subsoils can be avoided by moderate and frequent applications.

(2) The water is delivered under almost natural conditions, being aerated and the temperature raised in passing through the atmosphere from the sprinklers, circumstances which should tend to produce fruit superior to that raised under the flooding irrigation system.

(3) The installation costs should be very moderate, as in this instance 500 ft. of 2 in. reticulation piping was kept at the necessary pressure to distribute water from the sprinklers over a diameter of 20 ft., with the power supplied by a second-hand 2-horse-power slow-duty engine. The water was obtained by driving a pipe to a depth of 30 ft. The pipes are 18 ft. sections of thin sheet galvanized steel with wrapped edges, connected by a section of rubber hose with small clamp operated with eccentric clips, ensuring very rapid attachment and disconnection. The short lengths of connecting hose also enable the operator to embody curves and slight angles in the pipe-line. Screwing down of all sprinklers converts the pipe into a conduit for conveying water for any other purpose.

From his limited experience of this system the writer would recommend intending users to employ two lines of moderate length, for the following reasons : For some time after the water is shut off the surface of the ground irrigated is thoroughly waterlogged ; in consequence it is difficult to get about on, and such contact is best avoided until the free moisture has had time to percolate to a lower level. With two lines of piping no time need be lost in transferring pipes from one area to another, as one line can be in service while the other is being shifted.

GORE EXPERIMENTAL AREA.

NOTES ON OPERATIONS, SEASON 1927–28.

R. McGILLIVRAY, Fields Superintendent, and J. E. DAVIES, Assistant Instructor in Agriculture, Invercargill.

WEATHER conditions during the past season were not favourable for the growth of the various crops under trial at the Gore Experimental Area. Heavy rainfall was experienced in the early spring. October gave advent to fair conditions for cultivation, and during this month and early November the majority of the crops were sown. Crops generally germinated well and made a good start, but the cold period experienced during November and the first week of December, followed by a period of very dry weather from the New Year onwards, checked growth, and this was reflected in the final yields, and more particularly so in the case of swedes and potatoes. The rainfall at Gore for the year ended 30th June, 1928, was 32·84 in.

Farmers continued to take considerable interest in the various experiments throughout the season. The Gore Branch of the Farmers' Union held a field day at the Area during February. The attendance was large, and all branches of the work appeared to be of interest to those present. The agricultural class of the Wyndham District High School also visited the Area and had the scheme of experiments explained.

The area under cultivation was chiefly devoted to a continuation of the investigations in connection with plant-diseases, but manurial and variety trials were also undertaken.

CONTROL OF OAT-SMUT.

A continuation of last year's work was undertaken. The treatments were (1) formalin, (2) bluestone, (3) hot water; and the necessary controls were provided for. Periodical examinations of the various plots were made throughout the season. Smut was prevalent in the controls, and traces were found in the formalin and bluestone treatments, but the hot-water-treated plots were quite free from the disease.

GREEN FORAGE CROPS.

Chou Moellier.—This crop germinated well, with every sign of a heavy yield, but early in December it was attacked rather severely by grass-grub. This, together with adverse weather conditions, resulted in a somewhat uneven patchy crop. The outstanding feature was its resistance to club-root on land where other cruciferous crops were badly attacked. The manurial test comprised four comparisons, ten replications of each being made, with a standard of 2 cwt. superphosphate per acre. Results were as follows:—

	Tons per Acre.
A. Standard (superphosphate)	12·8
B. Standard, plus 1 cwt. blood	15·0
C. Standard, plus 1 cwt. 30-per-cent. potash salts ..	15·7
D. Standard, plus 1 cwt. blood and 1 cwt. 30-per-cent. potash salts	15·0

Throughout the period of growth the B, C, and D mixtures stood out prominently, the crop in these plots appearing more even, and plants showing more robust growth of stem and leaves.

Thousand-headed Kale.—This crop was grown in 26 in. drills, and up to the time of thinning in December made poor growth ; but during January growth was rapid, and a fair crop resulted. A striking feature in this block was a portion of the land which had not been limed. The line of demarcation was most distinct. On the unlimed portion the growth consisted of sorrel and weeds, with a few odd stunted plants of kale. On the limed area adjoining a good average crop was obtained without weeds being prominent. Phosphatic manurial trials were conducted, the plots being replicated seventeen times. Manures were applied at the rate of 2 cwt. per acre in each case. Results were as follows :—

	Tons.		Tons.
Superphosphate ..	15·7	Ephos phosphate ..	15·6
Seychelles guano ..	14·6	Nauru phosphate ..	14·3

No appreciable difference could be distinguished between treatments during growth, excepting that the Nauru plots were slightly slower in growth than the others.

POTATOES.

The pure line of the Up-to-Date variety that has been selected at this Area has been kept under close observation for another season, and weak and uncharacteristic plants were removed from the growing crop. This line can be said to be 100 per cent. pure, and the demand for seed is keen, but only a moderate quantity is on hand. Similar work on Arran Chief was got under way this season. It is hoped that in about a year's time a stock of pure line Arran Chief will be secured for distribution.

Control of Corticium Disease.—The work of testing clean potatoes against those affected with corticium disease was undertaken on an area of land ploughed out of grass. Clean seed was planted in plots consisting of four rows alternately with similar plots (controls) of seed affected with the disease. The clean seed plots made much quicker growth and stood out conspicuously over the adjoining controls, and reached their highest peak of growth early in January, when they suffered severely on account of dry weather. The controls, on the other hand, were fully a month later in growth, and were fortunate that at the height of their growth a warm rain fell. The results were outstanding and encouraging in the case of the clean seed, and the treatment points the way to the control of this disease. During April the plots were lifted and the tubers were carefully examined by a representative of the Field Mycologist. Thirty comparisons of weights were taken, the potatoes being graded in the field into three classes and weighed separately. Results on a per-acre basis were as follows : Yield from clean seed, 7·44 tons ; yield from controls, 5·69 tons ; difference in favour of clean seed, 1·75 tons. The clean seed was the progeny of seed treated with mercuric chloride and hydrochloric acid in the preceding season, and the seed this season was not treated. It showed 2 per cent. of corticium infection at time of planting. The

resultant crop showed 13 per cent. of infection, as against 100 per cent. infection in the controls.

Through the enterprise of the overseer thirty-eight varieties of potatoes were grown in small plots, and proved of great interest to many visitors to the Area. Some promising varieties were noted and will be tested again this coming season.

ROOT CROPS.

The yields of root crops were below the average, owing to climatic conditions. All cruciferous seeds sown on the Area, with the exception of two varieties of swedes, were treated with hot Semesan by Mr. J. C. Neill, Field Mycologist, as a prevention against dry-rot. These crops were kept under close observation from the early stages of growth until the end of June. Slight dry-rot infection was found in places in May, as compared with November infection in other seasons.

Swedes.

The manurial trial of swedes, in which various phosphatic fertilizers were used, created a great deal of interest. All the fertilizers were applied at the rate of 2 cwt. per acre. The series consisted of six different fertilizers, two drills of each, and replicated ten times. The plots all germinated satisfactorily except the superphosphate ones, which were uneven in growth and the plants yellow. These characteristics were in evidence for some time; as the season advanced the plants made rapid growth, but the crop was not as even as with the other treatments. During December a plant count was made. A 10 ft. rod was laid in the row, and the plants falling within were counted. This was done with each row, continuing in a line right across the block, forty counts being taken in each treatment. The average of the counts is as follows, representing number of plants falling within lengths of 10 ft.:—

Superphosphate	37·9	Walpole phosphate	55·3
Ephos phosphate	51·7	Nauru phosphate	55·8
Seychelles guano	55·1	Sulfurophosphate	53·7

The crop was weighed on 11th June, with the following results:—

	Tons per Acre.		Tons per Acre.
Superphosphate	19·4	Walpole	20·3
Ephos	21·4	Nauru	18·4
Seychelles	21·8	Sulfurophosphate	18·8

An area of Caledonian swedes was devoted to a trial of potash and super against a control of super alone. This was a very fine crop throughout, but was rather badly attacked with club-root. Results were as follows:—

	Tons per Acre.
Super, 2 cwt. per acre	39·0
Super 2 cwt., 30-per-cent. potash 1 cwt.	38·6
Super 2 cwt., muriate of potash ½ cwt.	38·3
Super 2 cwt., sulphate of potash ½ cwt.	40·0

A variety trial of swedes fertilized with super and Seychelles guano resulted as follows: Conqueror Green-top, 22·7 tons per acre; Smith's Victory, 28·4 tons; Vilmorin's Purple-top White, 33·4 tons. Vilmorin's

was a very even block, with sound roots deeply imbedded in the soil and hard to lift.

Turnips.

A block was devoted to the growing of Green-top Aberdeen turnips, and manurial trials were conducted with these. Each plot consisted of two rows, replicated twenty-eight times. The strike was uneven and yield low, but the roots were of good quality and average size. Club-root was in evidence, and in patches had reached an advanced stage. The crop was weighed on 5th June, with following results :—

	Tons per Acre.
Standard (1 cwt. super and 1 cwt. Nauru)	17·5
Standard, plus 1 cwt. 30-per-cent potash salts	18·9
Standard, plus 1 cwt. 30-per-cent. potash salts and 1 cwt. blood	20·1

The series containing potash was distinct throughout, and the complete manure gave a better start, but in the later stages of growth the various treatments could not be differentiated.

Mangolds.

Six varieties were sown and proved of interest to visitors, as very few crops of mangolds are to be seen in the district. Results, backed by those of previous seasons, show that a profitable crop can be grown. Variety yields were as follows :—

	Tons per Acre.
Barras Stryno V strain	29·5
Barras Taaroje Trifolium VI strain	26·2
Wiboltt's Dana Ovoid Giant Imp. strain	21·6
Sludstrup Yellow Long Ovoid	21·5
Half Sugar Giant Rose Marienlyst V strain	14·0
Taaroje Yellow Short Ovoid	13·8

A block of approximately 1 acre under manurial trial, with the Prizewinner variety, proved a fair crop. The standard manure was super, 2 cwt. per acre ; seeding, 4 lb. per acre ; number of replications, eight.

	Tons per Acre.
Standard	19·3
Standard, plus 1 cwt. blood	18·6
Standard, plus 1 cwt. blood and 1 cwt. 30-per-cent. potash salts	20·6

The crop was very even throughout, and consisted of sound-quality roots.

Carrots.

Half an acre of carrots was grown, and did well. The size and quality of the roots was excellent, but the crop was a thin one. Manuring consisted of 1½ cwt. super and ½ cwt. 30-per-cent. potash salts per acre. The average yield per acre was 24·6 tons.

SUGAR-BEET.

A small area of sugar-beet was grown at the request of the Gore branch of the Farmers' Union. The seed was sown in October ; manurial treatment was 2 cwt. super, 1 cwt. potash salts, and 1 cwt. blood per acre. Germination was satisfactory, and the plants made

splendid growth. The roots were lifted on 27th June, weights per acre being as follows: Australian, 26·3 tons; Bergamens, 29·3 tons; Kenwanzleben, 32·7 tons. The roots were large and rough. Bergamens appeared to be the best quality. Representative roots from each variety have been sent to the Department's Chemical Laboratory for testing for sugar content.

SPECIAL HAY CROPS.

An area of 5 acres was given to hay crops, subdivided into three equal blocks, all seeded at the rate of 3 bushels per acre, and manured with basic super at the rate of 2 cwt. per acre. The seed mixture in each block consisted of 1½ bushels of Crown oats, to which was added equal quantities of the following: Block 1, Partridge peas; Block 2, Scotch winter vetches; Block 3, Lathyrus peas. The crops were cut and weighed on 15th February, giving the following average yields per acre: Block 1, 6·5 tons; Block 2, 11·3 tons; Block 3, 5·5 tons.

The overseer, Mr. J. Sleeman, carried out the duties of his position in a most satisfactory manner, and Mr. H. Martin, contractor for cultural operations, made excellent work of the drilling, &c.

BORDEAUX AND LIME-SULPHUR SPRAYS.

COMPARATIVE TEST IN CANTERBURY ORCHARD.

L. PAYNTER, Orchard Instructor, Christchurch.

THE relative merits of bordeaux and lime-sulphur sprays on different varieties and kinds of orchard-trees in different localities is always a subject of interest and careful study among fruitgrowers. With a view to obtaining definite information on the point as regards his own orchard Mr. F. W. Cone, of Papanui, Christchurch, arranged and carried out during last season a specially designed spraying programme in co-operation with the Horticulture Division, the actual aim being the control of black-spot, red mite, &c. The trees given this treatment were Sturmer and Delicious apples only. The locality generally is rather dry, the average rainfall being under 30 in. per annum.

Particulars of the spraying schedule for the trials are presented in the following table:—

Date.	Stage.	Spraying Materials.	Variety.
26/8/27	Dormant ..	Red oil 1–10	Delicious.
26/8/27	Dormant ..	Bordeaux 8–6–40, red oil 1–100 ..	Sturmer.
26/9/27	Between tight and open clusters	Bordeaux 6–5–50, red oil 1–100 ..	Delicious and Sturmer.
10/10/27	Pink	Bordeaux 3–4–50, red oil 1–100 ..	Delicious and Sturmer.
29/10/27	Petal-fall ..	Bordeaux 1½–3–50, red oil 1–100 ..	Delicious and Six Sturmers.
		Lime-sulphur 1–100	Six Sturmers*

SPRAYING SCHEDULE—*continued.*

Date.	Stage.	Spraying Materials.	Variety.
14/11/27	Fruit-set ..	Arsenate of lead powder 1½ lb. to 100 gal.	Delicious and Sturmer.
29/11/27	Fruit good size ..	Bordeaux 1½–3–50, arsenate of lead 1½ lb. to 100 gal., red oil, 1–100	Delicious and Sturmer.
19/12/27	..	Sulpho 8–100, arsenate of lead powder 1½ lb. to 100 gal.	Delicious and Sturmer.
3/1/28	..	Sulpho 8 lb. to 100 gal., arsenate of lead powder 1½ lb. to 100 gal.	Delicious and Sturmer.
1/2/28	..	Sulpho 8 lb. to 100 gal., arsenate of lead powder 1½ lb. to 100 gal.	Delicious and Sturmer.

The remaining trees in the orchard, including Sturmers and Delicious, were sprayed with lime-sulphur, 1–10, at green-tip, 1–40 between open cluster and pink, 1–120 at petal-fall, 1–200 plus Sulpho and arsenate of lead three weeks later, the spray being thereafter repeated at the usual intervals.

Observations were recorded during the period of the test as follows, and should be read in conjunction with the tabulated spraying programme :—

12/11/27: Foliage superior on all trees sprayed with bordeaux plus 1 per cent. oil, except Six Sturmers marked *. These trees received lime-sulphur at petal-fall, following bordeaux; fully one-third of the foliage had fallen. Red spider much more in evidence on these trees than on remainder of orchard where lime-sulphur was used exclusively.

24/11/27: No spot in evidence on trees under test nor in remainder of orchard.

29/11/27: A few leaves now showing black-spot throughout the whole orchard. Showery morning, fine for spraying in afternoon. A period of showery weather previous to application and also following. Slight scorching of foliage after spray, 29/11/27.

19/12/27: Observations made showed black-spot more or less on trees under test, and also on remainder of orchard. Foliage 30 per cent. better on Delicious under test than in remainder of orchard.

31/12/27: Examined trees all through orchard, and found black-spot about equal irrespective of kind of spray used. Foliage 30 per cent. better on Delicious under test than in rest of orchard.

3/1/28: Weather conditions now set fairly dry.

1/2/28: Examined all trees. Found black-spot more or less in evidence all through the orchard, but infection very slight. Red mite now much more in evidence on these trees than remainder or orchard where lime-sulphur was used all through. Foliage on Delicious now inferior to remainder of orchard.

COMMENTS.

It will be noticed that at the petal-fall stage only half the Sturmers were sprayed with bordeaux, the remaining half receiving lime-sulphur. The result of this proved only what has been so long recognized—namely, that it is dangerous to follow bordeaux at pink with lime-sulphur at petal-fall.

One outstanding feature was the superior character of the foliage on the Delicious on which bordeaux plus oil was being used until the end of December. However, by the end of January the reverse was the case. Red mite had made such headway that the foliage was

fully 30 per cent. worse than on the remainder of the Delicious. At picking-time the results went to show that there was no advantage in bordeaux over lime-sulphur for the control of black-spot during the past season. The season was not such a bad one for black-spot, and therefore possibly results would be different when meeting a bad season.

The difference in the Sturmers sprayed with bordeaux as against lime-sulphur was very marked. The fruit generally was very much more russeted and also smaller in size. With the Delicious there was no difference apparent in the fruit.

The programme as outlined for the remainder of the orchard was practically carried out. Slight scorching took place with lime-sulphur, 1–10, at green-tip. A slight alteration in this programme is to be made for the coming season.

SEASONAL NOTES.

THE FARM.

SPRING SOWING OF PASTURES.

SHORT-ROTATION pastures are usually sown in the spring, either with oats or barley in September, or rape in November. Perennial rye-grass forms the bulk of the short-rotation mixtures, and it establishes readily enough in the early spring or early summer. In dry seasons the initial establishment of short-rotation pastures is nearly always bad, as the cereal or rape crop, being deeper rooted than the grasses, gets most of the soil-moisture. The only alternative to spring sowing with a cover-crop is to sow alone in the autumn. This adds considerably to the cost of establishment, and does not invariably lead to a better pasture. When sown in the autumn the pasture follows a cereal; in dry seasons or on heavy land it is often difficult to obtain a sufficiently fine, moist seed-bed for sowing in March, and if sowing is delayed until the ground has been weathered by the autumn rains it is often too late for successful establishment of the grasses and clovers.

Permanent pastures are sometimes sown in the spring, and this practice is usual in the far South where the winter frosts are severe. Spring sowing is also common on many North Island dairy farms where the pasture follows a winter rootcrop. Generally speaking, permanent pastures sown in the spring establish best without a cover-crop, and the pasture is best sown some time in September, so that the grasses and clovers may be well established before dry summer weather is experienced. Annual weeds are nearly always bad in a spring-sown pasture, and the weed-growth can be checked by mowing the pasture in November. Sorrel is usually a bad weed in young pastures on light land, and its growth can be checked very successfully by mowing the pasture in November when the sorrel is in flower.

The seed-bed for grass should be fine, moist, and firm. When sown with a spring cereal the grass-seed is usually sown in September,

after the cereal is up in the case of August-sown cereals, or as soon as the cereal is drilled if it is September-sown. In the latter case the land should be rolled after drilling, and the grass-seed and fertilizer broadcast on the rolled surface and covered with light tine harrows.

CROP-PRODUCTION.

Red clover for seed is usually sown with spring oats or barley, or with an autumn cereal which has been fed off in the spring. From 5 lb. to 6 lb. of seed should be broadcast and the seed covered with light tine harrows. Red-clover crops sown the previous year should be well harrowed and top-dressed with superphosphate before shutting up for hay some time in September.

As the autumn-sown cereals are fed off the land should be harrowed, so as to aerate the surface and scatter the clods which have been softened by the winter frosts.

Land for potatoes that has been skimmed in the autumn should be cross-ploughed in readiness for working up and planting in October.

Except in the far South, all spring cereals and cereal and legume mixtures for hay should be got in if possible by the end of August or early in September. If heavy rains are likely in September and the land is at all liable to hold the rainwater on the surface, it is often worth while to delay sowing barley till the end of the month or early October, so as to avoid the danger of the young crop being drowned out.

FEEDING OF DAIRY CATTLE.

September is usually a difficult month on dairy farms. If the weather is cold there is usually little grass-growth until the end of the month, and milking-cows suffer from the want of a sufficiently nutritious diet. Top-dressing in the autumn and shutting up pastures in June allows a good deal of the winter growth of grass to be saved for the spring, but this growth is usually finished by the end of August. Production then falls in September, when the bulk of the milking-cows' fodder consists of pasture-hay or hay and roots. The best hay should always be kept for the spring. Lucerne and clover hay are admirable for milk-production, and where these are not available the best pasture-hay (containing the most clover) should be kept for the spring. Failing the supply of good hay or grass the protein requirements of the milking-cows can be made up by feeding protein-rich concentrates. It is quite possible that the application of nitrogenous manures in July and August, as outlined in last month's notes, will promote a sufficiently vigorous early spring growth of grass to overcome the present difficulties of providing supplementary feed for September.

The winter and early spring feeding of yearling heifers is often very inadequate on dairy farms. The first winter is a most critical period in the life of a young cattle-beast, and its subsequent development depends very largely on how it was fed in early life. Calves should be the first stock to get a ration of hay in the early winter, as it is essential to get them used to hay and root feeding before the grass-growth seriously declines. Supplementary feeding should be continued in the spring until there is plenty of grass, so that the young animals' growth is not checked.

LAMB-MARKING.

Lambs are usually marked when four to five weeks old. Marking should be done during cool dry weather, and care should be taken that the lambs are not heated when marked. Marking during wet weather should be avoided, as it often causes heavy mortality. The operation should be carried out in temporary yards erected in a clean grass-paddock, so as to avoid risk of blood-poisoning. Care should be exercised in holding the lamb, and the hind legs should not be pulled wide apart, as this often ruptures the tissues in the crutch. The lambs should be released in such a manner that they land on their feet, and not so that the severed end of the tail becomes covered with dirt when the lamb reaches the ground. The knives and hands of the operators should be clean, and a tin of disinfectant provided in which the knives can be placed when not in use.

—P. W. Smallfield, B.Ag., Fields Superintendent, Auckland.

THE ORCHARD.

SPRAYING OPERATIONS.

It is recognized by all commercial orchardists that theearly sprays up to the blossoming-period are of vital importance for the control of fungoid diseases, and although there is a tendency in some districts to delay the first spray as late as possible this practice is not recommended—anyhow until such time as we have positive proof that the early or green-tip spray is of no value and can be dispensed with. Spores of fungus diseases as well as insect pests are lurking under bud scales, rough bark, dead twigs, &c., and are only awaiting a favourable opportunity to commence their activities. Fruit-trees at this time of the year can stand a much stronger spray than later, therefore a good application early, when the trees are just starting into growth, often prevents trouble as the season advances.

Just when to start spraying must be determined by the orchardists in the different districts, there being, of course, variations from Auckland to Bluff. The most important point is to be ready with all appliances in good order, so that no time is lost when spraying actually commences. Thoroughness is the keynote to success, and every care should be taken that all exposed surfaces are covered with the spray, since any portion missed may mean an open port of entry for disease. Many growers, knowing that spraying is a more or less disagreeable job, are apt to rush the work, and they then sometimes wonder why the results are not as good as those of the next-door neighbour who sprayed with the same mixture at the same time. Rather aim at spraying 5 acres per day properly than 10 acres just to get the work over. Weather conditions also play an important part in spraying operations. Should rain follow directly after spraying, it is advisable to repeat the operation, the main object being to keep a thin film of spray over every part of the tree.

Spraying programmes vary with the different districts and according to climatic conditions; consequently it is almost impossible to lay down any hard-and-fast rule suitable for the whole. If a grower has been successful in previous seasons with a certain programme he may be advised to adhere to it. On the other hand, if he is not getting the results desired the advice of the Orchard Instructor for the district should be sought.

The use of red oil at the dormant or bud-movement period is a very debatable point with growers, many claiming that the results obtained do not justify the use of such an expensive spray every season. However this may be, there is no doubt that it is a very beneficial spray, both for keeping insect pests in check and for the general good of the tree. Consequently it should be used at least periodically, at strength 1–15–25, according to advancement of the buds.

Many growers prefer a good bordeaux spray at the green-tip stage, especially on varieties such as Delicious and Sturmer. As there is no fear of russeting at this period, bordeaux at strength 6–4–50 can be used with safety. If lime-sulphur is preferred, 1–20 to 1–25 at the same period should be used. Owing to the chance of russeting with bordeaux it is advisable to switch over to lime-sulphur after the first spray, using a 1–40 solution at the open-cluster period.

Bordeaux is recommended for the control of black-spot on pears—an application of 6–4–50 at the green-tip stage, followed by 3–4–50 from the open-cluster to the pink period. An exception may be made with the Winter Cole, P. Barry, and Josephine varieties, using 1–60 lime-sulphur at the pink stage in preference to bordeaux.

For the control of leaf-curl, shot-hole, &c., on stone-fruits a thorough application of bordeaux at strength 6–4–50 when the buds begin to swell is recommended. This should be followed by either bordeaux, 3–4–40, or lime-sulphur, 1–50, at the pink stage. It is claimed by many that lime-sulphur at the pink stage is a great factor in the control of brown-rot, and consequently it should not be neglected, as this disease probably takes more toll than any other trouble stone-fruits are subject to.

CULTIVATION.

Early cultivation of the orchard is as necessary and valuable as the early spraying, and if the annual ploughing has not already been done it is advisable to attend to it as soon as the soil is in a fit condition. Where late autumn ploughing was done, with the intention of cross-ploughing in the spring, the operation may be deferred for a short time, but it is essential that the work should be completed before the trees start into growth and spraying operations commence. Cultivation round the trees, where it is impossible to work with the plough, is sadly neglected in many orchards. Trees dug or hoed round at this time of the year, turning under all sods left by the plough, dead leaves, rubbish, &c., will require very little further attention during the season, as the disks or harrows will keep the soil fairly clean. Turn in cover-crops about this time, giving the green material every chance to rot before the dry weather sets in.

MANURING.

It is only during the past few seasons that systematic manuring has been carried out in many orchards. Growers are realizing that it is impossible to get the best crops every season without returning to the soil plant-food taken out during the growing-period of the tree. Probably the latter part of August or the beginning of September is the best time to apply manure in the orchard, thus allowing the rains at that period to take it down into the soil. Each orchardist should find out what are the requirements of his orchard as far as manure is concerned, and apply it accordingly. By the growth of the tree, leaf-surface, fruitfulness, &c., a good idea can be formed as to whether phosphates, nitrogen, or potash is needed. Liming is also usually a beneficial adjunct to manure, and the application of 1 ton per acre every few seasons should not only tend to improve the soil, but make available much plant-food lying dormant.

—G. Stratford, Orchard Instructor, Motueka.

Citrus-culture.

The coming month is the most suitable period of the year for planting out all varieties of citrus-trees. There are instances where plantations set out as late as October or November have succeeded quite well, but in a general way September may be considered the best month. Fair rainfall may be expected to keep the young trees going, and the spring conditions are conducive to early establishment.

Possibly the most important factor in planting is that the soil should be in good condition, is well worked, friable, and not by any means sticky when worked to plant the trees. Trees should be firmly planted with the roots well spread. It is not feasible to plant firmly unless the soil can be compressed without sticking together, while to spread the roots well means breaking up the hard compacted ball of earth consolidated round them as usually received from the nursery. The subsoil immediately under the tree should not be disturbed to a greater depth than the surrounding subsoil, and though the soil should be firmed round the spread-out roots the top 2 in. of surface soil should be left loose.

Fertilizers may be worked in round the newly planted tree or mixed with the soil used to refill the hole, but they should as far as possible be kept from direct contract with the roots. Should the situation be in any way exposed the plants should be supported with a strong stake inclined towards the prevailing wind. The stake, not the tree, should be bound with sacking to prevent chafe.

Varieties recommended for planting are as follows :—

Lemons.—Lisbon : The well-known variety ; a thorny tree of constant cropping habit, the heaviest crop usually being harvested in late winter. Eureka : Equally desirable and fruitful as Lisbon, though the main crops are harvested in summer. Meyer : A newer variety of great promise ; should be tried in a limited way ; it is said to be more frost-resistant than other varieties.

Oranges (preserving).—Poorman : Generally succeeds quite well wherever citrus-fruit can be grown ; heavy and constant cropper of

medium to large fruits, the largest of which may be used as breakfast fruits; in season from May to September.

Oranges (sweet).—Navelencia: A naval of late season. Valencia Late: A Valencia navel of late season. Both these varieties under general conditions give a great range of sizes, many of which are below commercial size.

—*W. H. Rice, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

BROODER TROUBLES.

MANY poultry-keepers have sought my advice as to the poor results and troubles encountered in the artificial rearing of chickens, but with few exceptions the correspondents have failed to give full particulars relative to the special conditions under which the young birds are being reared, while, worst of all, no mention is made as to the particular make of brooder they are using. Thus it is next to impossible to even suggest the probable cause of the trouble.

There are now so many different styles of brooders and methods of working them that any instructions given in these notes or by letter could not be applied generally. Correspondents when asking for advice regarding the troubles they encounter should always give the name and the particular style of brooder they are using. Without these details it would be merely guessing on my part to express an opinion with any degree of certainty as to the probable cause of failure. Usually my correspondents merely give a few particulars relative to symptoms, such as droopy wings, &c.—symptoms which manifest themselves in affected chicks from almost any cause. On the other hand, in most cases the correspondents give full details relative to the food provided, thus indicating that in their opinion the food alone is responsible for the chicks' failure to live. For the successful rearing of chickens good food is always essential, but this is only one important link in the chain of management. The best food ration ever planned will not spell success if other essential details are neglected.

It is safe to say that chill is responsible for the loss of more chicks than all other things put together. For example, if chicks become chilled bowel trouble soon appears. Once this disorder sets in little or nothing can be done to save them, and it will generally pay in the long-run to destroy all chicks so affected rather than try to doctor them. In addition to bowel trouble there are other signs indicating chill, such as huddling, droopy wings, a distressed chirp, excessive thirst, and no inclination to leave the brooder or to eat. To prevent chill the brooder should be maintained at a more or less uniform degree of temperature, but it should be so arranged that the chicks are given an opportunity of moving away from the heat when it is excessive: Generally, if given the opportunity, and of course where they are not overcrowded, they will secure the degree of warmth that instinct demands.

Where brooders of the canopy type are used the chicks are afforded an opportunity of moving to and from the main source of heat, and securing a desired degree of temperature. It is true, however, that

even with this class of brooder the chicks will sometimes crowd into corners of the house, rather than remain in close reach of the brooder. The cause of this behaviour is usually put down to excessive heat in the brooder-room. Generally, however, it is due to a ground draught. Fresh air is of equal importance to desired warmth, but above all things it must be provided without draught. If there is a draught from any particular quarter the chicks will gradually move away from it until the corner is reached, indicating that they prefer to leave the chief source of heat (so essential for their welfare) rather than remain in a draught.

The huddling brings on a sweated condition, and this is fatal to chicks at any time. As a preventive I would advise placing on the floor of the house a board—say, 1 ft. high—a few feet away from the brooder, as a draught-break. If the behaviour of the chicks is observed the direction from which the draught is coming will soon be detected, so that the board or boards, as the case may be, can be placed in the right position. Of course, care must be taken that the chicks are given sufficient space to move well away from the heat when this is excessive, a condition which may easily happen when warm weather prevails. Chicken-rearing is a business of little details, and if these are not observed in every respect the best results cannot possibly be achieved.

The importance of cleanliness in the management of brooder chicks cannot be overestimated. Dirt means disease, infection, and the presence of vermin, and once these make their appearance mortality may be expected. The quarters should be kept sweet and clean by frequently renewing the bedding and litter material. Before new batches of chicks are moved to the brooder the whole of the quarters should be thoroughly cleaned and sprayed with a weak solution of sheep-dip or other suitable disinfectant. On no account overcrowd the brooder; it is one of the things which never fail to give trouble. It is always a safe policy to have too few chicks in the brooder than too many.

FEEDING OF CHICKS.

While a uniform degree of warmth, plenty of ventilation without draught, and strict attention to cleanliness are the chief factors in rearing brooder chicks, the matter of providing the right class of food must not be overlooked. There are numerous mixtures that will give equal results. The main point is to feed sound, wholesome food. Dry, coarse oatmeal is ideal for the first few meals. This may be followed by a reliable brand of chick-raiser. During the early stages it is a good plan to slightly moisten the broken grains with sweet milk or hot water some time before using. This will make the food more easily digested. Few people realize the value of dry coarse bran for young chicks. Right from the start it should be in reach of the little birds to pick at. An important point in rearing brooder chicks is to keep them well exercised. The best way of inducing this is to feed some chick-food in the litter and make them scratch for it. Grit, charcoal, and clean water should always be in easy reach right from the first, while finely cut succulent green material should be fed daily after the third day.

GIZZARD COMPACTION IN CHICKENS.

Many poultry-keepers make the mistake of not conducting a post-mortem examination on any chicks that die, for the purpose of ascertaining, if possible, the cause of death. Such examinations often give clear proof of the cause and nature of the trouble, and indicate preventive methods. Thousands of chickens die annually through eating long fibrous green material which rolls up in a tangled mass and will not leave the gizzard. The pickings from curtains, sacking, &c., will have a similar effect. Much mortality also takes place when they are supplied with grit or bedded with sand containing a large proportion of glittering mineral particles, which they pick up. These particles accumulate in the gizzard, and death rapidly follows. Many of the brooder losses could be prevented if these injurious substances were kept out of reach of the motherless chicks that have not attained the age when they can be trusted to look after themselves.

Some of the so-called wheat pollard containing a high proportion of fibrous material, such as finely ground husks, is also often responsible for gizzard compaction and its evil effect. Although finely ground, the fibrous material contained in the pollard will not leave the gizzard. As a result this organ becomes packed to its utmost with the fibrous substance, and consequently the chickens die from starvation. Young chicks have not the power to assimilate hard fibrous material, however finely it may be ground. Obviously, to compel them to eat any mixture containing a high proportion of this material is simply courting disaster. Unless pollard is known to be the genuine article it should never be included in the ration for birds of any age, and particularly is this the case where growing chickens are concerned.

The joints from grain-stalks are often eaten by chicks when bedded with chaff, causing gizzard compaction and finally death. This trouble may be minimized by giving the little birds a light meal before leaving the incubator. After securing a dainty meal the chicks will be less inclined to pick up any fibrous matter that may be in reach of them when transferred to the brooder. Much of the trouble due to gizzard and crop compaction would be avoided—whether it be with old or young stock—if sharp gravel grit were always available for the birds to pick at. It is true that some birds under certain local conditions will do well on broken sea-shell alone. In a general way, as a preventive of digestive troubles, sharp gravel grit is always advisable.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

SPRING WORK.

With the advent of spring weather no time should be lost in pushing on with essential work not already completed. Repairing and painting old hives, provision for increase, laying in stocks of foundation, and making and wiring frames should be taken in hand. Neglect to pay attention to these important matters leads to heavy losses each successive season. A surplus stock of supplies should be kept in anticipation of a honey-flow and increase at swarming-time, not

only by the commercial apiarist but also by the small beekeeper producing honey for home consumption. The successful apiarist makes sure that he has on hand plenty of spare equipment to carry the work through the summer season. Some idea of what is required may be gained by observing apiaries in operation.

Every advantage should be taken of the fine spring days to examine each colony for the purpose of noting the quantity of stores, the general condition, and whether queenless or weak. If the examination reveals plenty of stores in the combs all will be well, but, if not, artificial feeding will be necessary to carry the colony through until sufficient honey is coming in from the fields.

Fruit and willow blooms are a considerable help, but must not be relied on absolutely to starve off starvation, as climatic conditions are not always favourable to the flight of the bees. In any case nectar from these sources will not always suffice for the needs of the bees, except under favourable conditions (and then in few localities) where willows are plentiful. When brood-rearing has commenced in earnest the food-supply must be kept in mind, and periodic examinations undertaken to see that the stores do not give out before the arrival of the clover-bloom. If the colonies are weak in bees little advantage is gained in trying to pull them through until the hives are populous. By far the best practice is to unite them with stronger colonies, as there is a danger of weak colonies being robbed out. The surplus stores can be distributed among those in need of them. If on the first examination queenless hives are found these should be united at once, as it is yet too early to rear queens and get them successfully mated. Queenless hives promote wholesale robbing, and on no account should be tolerated during the spring months when there is a dearth of honey.

FOUL-BROOD.

Another important seasonal matter is keeping a constant lookout for signs of disease. Any colonies in an unhealthy condition should be marked for treatment during the first flow of honey. Every precaution should be taken with colonies that are affected with disease to prevent them from being robbed. Do not leave hives or their inside fixtures in exposed positions after they have been in contact with disease, or visiting bees may be the means of spreading the trouble to healthy colonies. At all times the beekeeper's efforts should be in the direction of keeping his colonies strong and healthy.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

THE TOBACCO CROP.

A FURTHER sowing of tobacco-seed towards the end of August is usually good policy. By having a part of the crop a fortnight or so later than the remainder, the planting season, as well as the harvest, is spread over a convenient period, and the work is done better than

when it has to be either rushed through or much of it is done when the plants are past their best condition. Light crops and poor cures are very commonly due to the plants being soft, blanched, and overgrown when planted out, and to much of the leaf being over-ripe when harvested. Those growing an experimental crop will find a small second sowing now an insurance against accident from weather, disease, or inadvertence.

Early September is the time for pricking out the first of the seedlings into the seed-beds. If the seedlings arrive from the nurseryman in boxes it will be as well to keep them undisturbed in a scrim-covered cradle so as to thoroughly harden them before planting out. During the earlier part of this period they should be kept a little drier than usual.

The operation of pricking out the seedlings is conveniently done by two persons, one on each side of the 4 ft. seed-bed. With a thin, narrow board of hard wood, a little shorter than the width of the bed, and having a bevelled edge, a cut 1 in. or so deep is easily made in the prepared friable soil; the seedlings are then lifted, placed against the perpendicular cut face, and the soil is then drawn up to complete the covering of the roots. When a row is planted the covering is completed and pressed firm with the board, and another started as before 1½ in. from the last. A light watering with a fine rose will settle the soil about the plants, which should then receive the shade and protection of cheesecloth stretched and fastened over the bed. A thin hessian will serve the purpose, but a close woven fabric is unsuitable, as owing to the lack of air the plants are liable to damp off. The cloth should be supported by cross-timbers to keep it from sagging. Where only a few plants are being grown they should be pricked out 1 in. or so apart in shallow tray boxes, lightly watered, and put back in the frame to be further grown.

While the seedlings are being grown the land in which they are to be planted out should be undergoing preparation. While the most suitable soil for the tobacco crop is not the richest and heaviest, but a medium-light friable soil, it should be ploughed early to turn in grass and weeds to rot, and afterwards receive cultivation from time to time to destroy seedling weeds. This working will also destroy insects pupating in the soil, or uncover them for the benefit of the birds, which busily search freshly turned land. Such preparation is the best method of preventing the depredations of surface caterpillars or cut-worm—the larvæ of various moths—which sometimes cause wholesale losses by cutting off the young plants at the surface of the ground soon after they are put out; or wire-worm, the larvæ of click-beetles, which feed voraciously on the roots of young plants and prevent them growing. Good and timely preparation of the land will greatly facilitate and cheapen production in the field. The quality of the leaf is best where the soil is in sweet condition. If necessary, apply a good dressing of lime directly after the first ploughing.

TOMATOES.

The tomato crop under glass requires skilful nursing during the spring months if the more valuable early crop is to be gathered in good quantity and condition. If the plants stop growing, or if they

receive a check of any kind, the early crop is going to suffer. Damage of this kind is usually caused through careless ventilation or watering. Give these two operations carefully studied manipulation, and the plants an application or two of bordeaux to keep the bottom foliage right, and there should be little trouble. Also, do not cultivate too deeply now—only just deep enough to keep the weeds down.

Plants for the main outdoor crop will soon be ready for pricking out. Do this when the first rough leaves develop, rejecting all poor and abnormal types. Careful culling should be done at this stage; put the plants back in the frames and grow them on steadily. Remember high temperatures now do almost as much damage as low ones, and carefully attend to ventilation. Prepare the land now for planting out. Turn in the cover-crop, if one is being grown, so that it will have ample time to rot. Good preparation takes time as well as labour.

SMALL-FRUITS.

Brakes of small-fruit bushes or strawberries will require shallow hoeing in bright weather to kill weeds, and such sprays as are necessary to keep them clean. "Leaf-spot" of various kinds is very apt to be troublesome now on the foliage of all classes of berry fruits, and good 4–4–40 bordeaux is the best preventive. Under our system of culture most crops will benefit from a dressing of chemical fertilizers now. Give the formula careful consideration. Stunted plants would benefit from the inclusion of a little ammonia, but at this season it is better to give too little rather than too much of that ingredient, especially to herbaceous plants that are very responsive.

VEGETABLE CROPS.

As crops of winter cabbage, broccoli, &c., are now used up, the land should be taken in hand without delay and prepared for the next crop. Such land is generally in excellent condition for root crops, after suitable cultivation. Cabbage, cauliflower, and lettuce planted out in late autumn and early spring for spring cutting will now be making growth, and may be fed with nitrates as required.

Asparagus and rhubarb are important crops now being harvested. To enable the plants to do their best give them a dressing of suitable manures. For the asparagus crop a mixture composed of three parts common salt, two parts superphosphate, two parts nitrate, and one part sulphate of potash would be suitable in many instances, applied at the rate of 2 oz. per square yard or 5 cwt. per acre. Following the winter dressing of organic manures the rhubarb crop should now be given 3 cwt. superphosphate and 2 cwt. nitrate of soda per acre.

The present is a suitable time for making new plantations of asparagus. For commercial crops the land must be light, rich, and moist. Put out one-year-old plants 18 in. apart with 3 ft to 4 ft. between the rows. Cover the roots with 2 in. to 3 in. of soil now, but plant sufficiently deep so that when the furrow is completely filled the crowns will be at least 5 in. beneath the surface; plant firmly. New plantations of rhubarb are usually made in summer after the spring crop is gathered.

The planting and sowing of all the remaining hardy annual main crops should now be completed. Take advantage of bright dry weather to hoe seedling crops, and in dull showery weather thin them out. Prepare land for the half-hardy crops to be sown and planted at the end of October and beginning of November, and for seed-beds for winter vegetables to be sown next month.

THE FARM-GARDEN.

House supplies on the farm are often grown, fruit and vegetables together, with but little success. Some intercropping between fruit-trees may be done successfully while the trees are small, but as soon as they are big enough to bear, or even before that, intercropping with vegetables should cease, as it is mutually unsuitable. This is particularly bad when the trees are planted rather close together. A good method often is to plant the main vegetable crops out in a nearby paddock with the farm root crops. Peas, potatoes, cabbage, onions, &c., may be grown very well in this way with horse implements. The enclosed garden near the house can be used with advantage for such permanent crops as asparagus, rhubarb, herbs, and bush fruits; also annuals such as tomatoes and salads; and for seed-beds where plants may be grown before putting them out in the field. This can be a very useful and interesting little section if it is sheltered and well managed. With a garden-house containing a few chemical plant-foods and specifics, also suitable implements, this is a section that could be very well managed by ladies who have a taste for gardening.

—W. C. Hyde, Horticulturist, Wellington.

ROSELLA PARAKEETS.

Of late years a small Australian parrot called Rosella has become established in the Waitakere Ranges, near Auckland. The birds are often seen in orchards and gardens within a few miles of the Waitakeres, and are reputed to do considerable damage. It is considered desirable that they should be exterminated if possible. They may be shot at any time of the year without a license, and are good eating. The Department of Internal Affairs has decided to grant no further permits for the importation of these birds.

BOOKS RECEIVED.

New Zealand Trees and Shrubs and how to Identify them. By H. H. Allan, M.A., D.Sc., F.L.S., F.N.Z.Inst. Whitcombe and Tombs, Ltd., Christchurch, &c. 6s. 6d.

Cawthron Lectures, Volume III. The Cawthron Institute, Nelson.

The Sheep and Wool Industry of Australia and New Zealand. By Henry B. Smith; revised in conjunction with Harold Haile. Third edition. Whitcombe and Tombs, Ltd., Christchurch, &c. 10s. 6d.

Imperial Agricultural Research Conference, 1927: Report and Summary of Proceedings. His Majesty's Stationery Office, London. 1s.

The Pig Breeders' Annual for 1928–29. The National Pig Breeders' Association, 92 Gower Street, London W.C. 1. 2s. 6d.

EXPORT OF EGGS, 1928 SEASON.

CONDITIONS OF GOVERNMENT GUARANTEE.

THE conditions under which the New Zealand Government offers a guaranteed return on eggs shipped from New Zealand to London are as follows :—

1. The guarantee is only available to the producer of the eggs, and refers only to shipments of hens' eggs made to London during the 1928 season.

2. The guarantee is that the Department of Agriculture will pay to the New Zealand Poultry Association, as soon as practicable after account sales for all shipments for the season are received by the Department, such sum as is necessary to enable the association to pay to the producer an amount sufficient to make the average gross wholesale price received by him on the London market not less than £3 5s. per case for his proportion of the shipments under the guarantee throughout the season. Thus the price for individual cases or shipments is not guaranteed, but an average of not less than £3 5s. per case for each producer's total shipments is assured.

3. The guarantee is limited to eggs produced and shipped (otherwise than under an f.o.b. contract) by poultry-keepers or co-operative associations of poultry-keepers ; shipped through the New Zealand Poultry Association to London agents approved by the Department of Agriculture after consulting the association ; and adequately insured against fire and marine risks from the time of shipment till the time of sale, to the satisfaction of the Department of Agriculture.

4. The eggs shall be sent to one of the grading-stores referred to in clause 6 of these conditions, graded for size, and packed in strong clean cases with cardboard fillers or other suitable carriers, so as to prevent damage in transit to the grading-store. The tray-system case is recommended. The eggs shall not be packed in chaff.

5. The eggs shall weigh not less than 2 oz. each, and shall not have been preservatized or refrigerated. They shall be clean and free from stain, non-fertilized, normal in shape, uniform in size, and sound in shell, and shall have the air-cell less than $\frac{3}{16}$ in. in depth.

6. Each consignment shall be submitted at the store by or on behalf of the producer to the manager of one of the grading-stores arranged for by the New Zealand Poultry Association, and approved for the purpose by the Department of Agriculture. There shall be delivered to the manager with each consignment a written advice of the number of cases and eggs contained therein, together with a distinguishing mark or brand, such advice to be available for the information of the grader as required.

The eggs shall be graded and repacked as provided for in clause 8, and the grader shall, on the form provided, advise the manager of the number of eggs passed for export, and the manager shall thereupon advise the consignor.

7. The manager shall be accountable for all eggs rejected for export, and shall notify the producer, or any agent nominated by the producer, when such eggs, together with the cases, carriers, &c., used in transit to the grading-store are available for delivery.

8. All eggs so submitted for export shall be individually examined by or under the direction of the Department's grader, and those passed by him shall be repacked to his satisfaction into new cases (as described in clause 10 of these conditions) supplied by or on behalf of the producer. No fee will be charged for the personal services of the grader, but the producer shall arrange with the manager to provide the assistance required by the grader, to the latter's satisfaction. All charges connected therewith, including taking delivery of the eggs, use of the grading-store, packing, provision of cases and fillers, storage, shipping, freight, insurance, and marketing shall, unless otherwise arranged for by the producer, be borne by the association and charged to the producer, *pro rata*.

9. The standard cases into which all eggs for export shall be repacked shall be supplied by the producer, shall be made of clean, dry, odourless wood, and shall comprise two compartments, each of $11\frac{3}{4}$ in. by $11\frac{3}{4}$ in. and 13 in. high (inside measurements). The ends and partition shall each be of one board measuring $11\frac{3}{4}$ in. by 13 in. by $\frac{5}{8}$ in., both end boards to be dressed on the outer

side. The top and bottom shall be of boards of 25⅜ in. by 6 in. by ⅜ in., and shall be nailed flush with the sides of the case, leaving a space of ½ in. in the middle. The sides shall each be of three boards, 25⅜ in. by 4 in. by ⅜ in., and shall be so nailed as to leave spaces of ½ in. each between the middle and outer boards. A wooden cleat of 12½ in. by 2 in. by ⅜ in. shall be nailed to each end of the case so as to be level with the top of the case and to project ⅜ in. therefrom.

Each case shall be fitted with new, heavy, dry white manila-board fillers and flats, with pads of kiln-dried wood-wool approved by the grader, one of these pads being placed in each section at bottom, centre, and top of case.

Each case shall be branded with the expressions "New Zealand Eggs" and "30 dozen" in black letters not less than 2 in. in height, on each side, and with the name and shipping-mark of the exporter on one end, the other end being reserved for a label, with sufficient clear space for the grader's stamp. The weight per long hundred of each case shall also be stamped on each end.

10. All eggs shipped under the guarantee shall have been passed for that purpose by the Department's grader, a certificate to that effect obtained from the grader by the shipper, and the cases stamped by the grader to show that the eggs therein have been passed.

11. No eggs passed by the grader for shipment shall be removed from a grading-store except to be forthwith shipped to London, or to be placed and held, with the approval of the grader, in cool storage prior to such shipment.

12. All eggs coming under the guarantee shall be carried on the ship in cold storage under conditions suitable for keeping them at a temperature of about 34° Fahrenheit.

13. If any eggs, after being graded and prior to their export from the Dominion, become damaged, or, in the opinion of any grader, deteriorated from any cause whatever, the owner of such eggs shall, if and when directed by the grader so to do, submit such eggs for re-examination, and surrender to the grader the grade certificate issued in respect thereof.

14. The Government reserves the right to withhold the guarantee from eggs shipped in vessels the cold-storage facilities of which are deemed by the Department of Agriculture to be unsatisfactory for the carriage of eggs, or from eggs forwarded for grading at times other than those arranged between the New Zealand Poultry Association and the Department of Agriculture, such times to be in no case later than 15th November, 1928, unless in exceptional circumstances the Department agrees to a later date.

GRADINGS OF BUTTER AND CHEESE, SEASON 1927-28.

THE Dominion quantities of butter and cheese graded for export by the Dairy Division during the twelve months ended 31st July, 1928 (the dairy industry year), were as follows:—

Butter: Salted, 71,605 tons; unsalted, 3,118 tons: total, 74,723 tons—an increase of 4·2 per cent. compared with the figures for the preceding twelve months.

Cheese: White, 49,415 tons; coloured, 26,338 tons: total, 75,753 tons—a decrease of 0·73 per cent.

In butterfat equivalent the 1927–28 amounts for butter and cheese combined represent a net increase of 2·59 per cent. compared with those for 1926–27, hitherto the peak year. A new high-level record in butterfat production has thus been established.

Review of "Plant Hunting."—In Dr. L. Cockayne's review of E. H. Wilson's book "Plant Hunting," in last month's *Journal*, it was stated that the number of pages in the book was 276, whereas there are 524. The mistake arose from the fact that each volume of the work is paged separately—an unusual proceeding—and that the reviewer looked for the total number of pages at the end of the second volume, and concluded that number (276) referred to the whole work.

WEATHER RECORDS: JULY, 1928.

Dominion Meteorological Office.

GENERAL NOTES.

THERE was a marked contrast, as regards rainfall, between the weather experienced during the month in Auckland Province and that enjoyed by the remainder of the Dominion. Except for part of the Bay of Plenty district, the rainfall was considerably below normal over most of the northern province, and there were heavy floods in North Auckland and the Waikato and Waihou Valleys.

Approximately average falls were received over much of northern Taranaki, Nelson, and Marlborough, and in parts of central and southern Otago and Southland the registrations were in excess of the average. In all other districts south of Auckland the month was a dry one. The shortage of rain was very pronounced in Canterbury, especially in the northern part of the province.

In the first half of the month there were some fairly general rainfalls and the weather was at times stormy, but thereafter fine weather was the rule in all the central and southern provinces. In contrast with June, temperatures were everywhere remarkably mild. Frosts were numerous in the South Island but seldom severe, and there was a marked absence of snowfall except at very high levels. Sunshine was more abundant than usual. The absence of westerly winds was no less marked than in the preceding months of the year.

The rainfall of the month was associated chiefly with three cyclonic storms. The first of these moved from the Tasman Sea towards the Auckland Peninsula on the 7th, and, moving thereafter in a more southerly direction, crossed the South Island on the night of the 8th. General rain fell between the 7th and the 9th, with heavy falls in many parts. In North Auckland, where the precipitation was heaviest, there was heavy flooding in the rivers. Gales were caused in many places by this storm.

The second of the cyclones mentioned moved slowly from the North Tasman Sea and away eastward across the Auckland Peninsula between the 22nd and the 25th. On this occasion the heaviest rains fell in the Waihou and Waikato River Valleys, and serious floods reached their culminating-point on the 24th or 25th. In parts of the Waihou watershed the flood was a record one. At Waihi, for the four days ending at 9 a.m. on the 25th, a total rainfall of 19·80 in. was recorded. This storm produced comparatively little effect south of New Plymouth and Gisborne.

The third cyclone followed a somewhat similar track between the 29th and the 31st. It was of smaller area than the preceding ones and its effects still more restricted. There were some heavy rainfalls, however, in the Thames, Coromandel, and East Cape districts, and rivers were kept in a flooded state till the end of the month.

Though each of these storms was responsible for gales in places, they were not, as a rule, prolonged, and comparatively little damage was done by them.

In the South Island the prevailing winds were from the south-west, and in exposed positions they were occasionally strong.

—*Edward Kidson, Director of Meteorological Services, Wellington.*

RAINFALL FOR JULY, 1928, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall	Average July Rainfall.
	North Island.	Inches.		Inches.	Inches.
1	Kaitaia	6·48	11	2·90	5·96
2	Russell	5·79	13	1·37	4·97
3	Whangarei	10·36	15	2·90	7·26
4	Auckland	8·53	24	2·22	4·98
5	Hamilton	5·59	13	2·04	5·02
6	Kawhia	6·84	14	2·04	6·16

RAINFALL FOR JULY, 1928—*continued.*

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
	North Island continued.				
		Inches.		Inches.	Inches.
7	New Plymouth	7·31	13	2·21	6·29
8	Riversdale, Inglewood ..	9·76	16	3·12	9·93
9	Whangamomona	6·94	9	2·05	7·35
10	Eltham	5·61	15	2·35	5·55
11	Tairua	14·40	14	4·59	5·25
12	Tauranga	5·17	15	1·06	4·86
13	Maraehako Station, Opotiki	3·24	10	0·96	4·09
14	Gisborne..	5·19	17	1·53	5·14
15	Taupo	4·26	9	2·16	3·83
16	Napier	1·44	16	0·41	3·90
17	Maraekakaho Stn., Hastings	2·33	19	0·50	3·65
18	Taihape	1·56	13	0·44	3·15
19	Masterton	0·99	16	0·26	4·31
20	Patea	2·55	10	1·58	4·20
21	Wanganui	1·11	6	0·60	3·52
22	Foxton	2·16	9	..	3·09
23	Wellington (Karori Reservoir)	3·70	13	1·45	5·22
	South Island.				
24	Westport	6·33	17	1·12	6·99
25	Greymouth	4·26	16	0·87	7·84
26	Hokitika	6·26	17	1·60	9·08
27	Ross	6·49	10	0·98	9·94
28	Arthur's Pass	9·16	11	2·28	11·55
29	Okuru, Westland	10·12	10	2·10	12·03
30	Collingwood	9·75	13	2·71	9·65
31	Nelson	3·20	5	1·88	3·49
32	Spring Creek, Blenheim ..	3·57	6	2·27	3·40
33	Tophouse	3·31	10	1·02	4·79
34	Hanmer Springs	0·99	9	0·21	4·59
35	Highfield, Waiau	0·32	3	0·20	3·44
36	Gore Bay	0·28	2	0·25	2·84
37	Christchurch	0·48	8	0·16	2·76
38	Timaru	0·42	9	0·22	1·93
39	Lambrook Station, Fairlie ..	0·56	4	0·22	2·61
40	Benmore Station, Clearburn	0·78	8	0·28	1·73
41	Oamaru	0·64	7	0·33	1·74
42	Queenstown	1·84	5	0·58	2·04
43	Clyde	1·54	5	0·52	0·94
44	Dunedin..	1·38	11	0·33	3·01
45	Wendon	2·12	10	0·48	1·79
46	Gore	2·54	14	0·78	1·94
47	Invercargill	3·60	17	0·68	3·28
48	Puysegur Point	8·93	19	1·06	6·18
49	Half-moon Bay, Stewart Is.	4·84	13	0·81	4·13

Weight of Sheep and Lamb Carcasses exported.—The average weights of mutton and lamb exported during the past season to 30th June, as compiled by the Meat Producers' Board, are as follows (figures for the season 1926–27 being added in parentheses): Wethers, 56·7 lb. (55·9); ewes, 55 lb. (54·5); lambs, 34·6 lb. (34·8).

Wellington Winter Show.—The dates for this show (which has been retarded by lateness in construction of new buildings) are now fixed for 19th September to 6th October next.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

AMPHISTOME WORMS IN COW'S STOMACH.

"FARMER," Kaikohe :—

On opening up an old cow, which we killed and boiled up for the pigs, I found masses of worms adhering to the lining of the stomach and mixed with the contents. The worms were the colour of ordinary ground-worms, about ½ in. long, thick at one end and thin at the other. The thick end would be as thick as a slate-pencil, while the thin end came to quite a sharp point. I should be glad of any information about them—cause, cure, &c.

The Live-stock Division :—

These worms are technically known as *Amphistoma conica*, and belong to the fluke family of parasites. The life-history of these parasites is not known in detail, but it is believed that they do no appreciable harm to their host. Diagnosis of the presence of these parasites is impossible under ordinary conditions, and, if diagnosed, it would be a difficult matter to kill or expel them, owing to the large amount of material in the paunch of cattle and the consequent dilution of any drug used for such a purpose. No deleterious effect having been known to be due to these amphistomes, medicinal treatment for their removal is not advocated.

TUNG-OIL TREES.

A. C. MAISEY, Redwood's Valley :—

Can you tell me what chance the tung-tree (*Aleurites cordata*) would have in the Nelson District? Is it grown from seed, cuttings, or plants? And how and where they could be procured?

The Horticulture Division :—

It is most likely the tung-tree would do very well in the Nelson District, and the Department of Agriculture is now raising trees with a view to testing the question. If this trial is successful there should be ample material for propagation and extending the plantings. There are a number of species of *Aleurites*, some of which are inferior and others quite unsuitable for commercial oil production. *Aleurites cordata*, the species mentioned by you, is one of that class.

HEATING OF TOMATO-HOUSE.

WILSON BROS., Otekaike :—

Will you please let us know which is the best way—taking cost into consideration—to heat a tomato-house 40 ft. long by 16 ft. wide; also where the pipes are placed, &c. Electricity is available.

The Horticulture Division :—

Economical heating of the small tomato-house you describe would depend very much on the season of ripening the crop. To ripen in November and December a few small electric radiators or kerosene-stoves would provide protection against a hard late frost, and with careful manipulation of the ventilators this plan should be quite satisfactory. For earlier crops more heat would be required, but such crops are rarely payable, owing to the Cook Islands supplies, which are even now on the market. This class of heating would require 4 in. cast-iron pipes best laid once round the house just inside the foundations. Whether fuel or electric current should be used would depend on the price of the latter and the hours you were allowed to use it. The electrical system has the further advantage of great simplicity, and the work of stoking and the cost of buying and installing a boiler and furnace is dispensed with.

METHODS OF MILKING.

W. T. LOCK, Okoia :—

Would you let me know if it makes any difference milking the back quarters of a cow before the front ones? Does it drive the milk to the back quarters; and, if so, why?

The Live-stock Division :—

It makes no material difference whether the back quarters are milked first. As there is little communication between the fore and hind quarters of the udder on the same side, the secretion in the one quarter is not influenced to any great extent by that in the other. At the same time the usual practice in hand-milking is to remove part of the milk from the two back quarters, followed by part from the fore quarters, or *vice versa*, until the udder is emptied.

THE JAPANESE WALNUT.

J. D., Okoia :—

I have a few trees, about ten years old, which I bought as Japanese walnuts. They bore this year for the first time. The nuts are in clusters like bunches of grapes and very small, not worth using. Are they likely to increase in size, or are the trees only ornamental? The trees are beautifully shaped, and would make good shade in a paddock for stock, but I am afraid I got the wrong sort.

The Horticulture Division :—

From the description given, your trees are no doubt true to name. The Japanese walnut that has been distributed is very ornamental and useful as a shade-tree. The nuts, however, are very disappointing for edible purposes.

BLACK-CURRANT BUSHES FORMING NO FRUIT.

C. ELLIS, Hunterville :—

My black-currant bushes flowered well last spring, but no fruit formed. The bushes are young and vigorous growers. Can you give me any explanation? There were no heavy frosts.

The Horticulture Division :—

If your black-currant bushes are young, vigorous, and blossomed well, but set no fruit, it is probably due to a check of some kind given them at the time of fruit-setting. What caused this one can only guess. You are advised, however, to avoid deep cultivation that may disturb the roots during the spring and early summer.

WARTS ON COW'S TEATS.

C. D. SUTTON, Te Horo :—

Is there any cure for warts just forming on a cow's teats? The cow is in milk.

The Live-stock Division :—

A mild application recommended for the suppression of warts forming on a cow's teats is a dressing of castor-oil after each milking. If the warts continue to increase in size it is advisable to use some caustic agent such as silver nitrate, applied carefully after each milking. When a number of warts are present, however, it is more convenient to wait until the cow has been dried off, when the warts may be snipped off with a pair of surgical scissors, the surface being lightly touched with the caustic or painted with tincture of iodine.

NOTE.—"Pioneer," who inquires regarding grass mixtures, &c., has omitted to give his name and address. These are required.

EXPORTS OF NEW ZEALAND PRODUCE FOR YEAR ENDED 30TH JUNE, 1928.

Item.	Unit.	Quantity.	Value.
			£
Butter	Cwt.	1,467,954	11,315,756
Casein	,,	44,372	141,430
Cheese	,,	1,529,872	6,360,766
Fish	,,	24,702	85,562
Beef, frozen	,,	692,231	977,623
Lamb, frozen	,,	1,865,784	6,669,196
Mutton, frozen	,,	1,095,937	2,085,607
Beef, salted	,,	4,990	10,685
Meats, potted and preserved	,,	68,316	237,306
Sausage-skins	Lb.	3,715,870	766,345
Milk, preserved	,,	1,091,497	27,513
Milk, dried	,,	12,414,035	318,964
Beans and peas	Centals	208,227	180,559
Oats	,,	260,739	111,155
Apples, fresh	Lb.	39,651,282	496,870
Hops	,,	406,350	22,612
Potatoes	Tons	951	7,755
Live-stock	..	..	114,224
Calf-skins	Number	750,408	245,947
Hides, horse and cattle	,,	451,476	903,834
Rabbit-skins	,,	12,333,438	633,090
Opossum-skins	,,	133,344	77,587
Sheep-skins, with wool	,,	1,371,790	488,206
Sheep-skins, without wool	,,	8,626,621	1,296,428
Wool	Bales	667,225	16,548,869
Phorium-fibre	Tons	13,921	391,759
Seeds, grass and clover	Cwt.	75,827	291,161
Tallow	Tons	29,510	882,297
Coal	,,	120,688	172,468
Kauri-gum	,,	4,588	245,834
Gold	Ounces	125,855	518,468
Silver	,,	437,609	43,711
Leather	..	..	20,787
Timber, sawn	Sup. ft.	35,389,421	398,474
Other New Zealand produce	..	..	1,095,697
Total Value	..	..	54,184,545
Total for Year ended 30/6/27	..	..	45,457,491

In addition to New Zealand produce, re-exports from the Dominion in 1927–28 amounted to £1,434,740, and in 1926–27 to £937,591.

Pig Industry Investigations.—At the July meeting of the Research Council the Chairman reported on this subject as follows: "The establishment of three pig-recording investigations at Lincoln College, Massey College, and in the Waikato, has met with a very good response. In all instances no difficulty has been experienced in securing the ready co-operation of farmers in the scheme, and the recording officers will be fully occupied in weighing regularly the large number of pigs which have been offered for the test. The large amount of information which will be gathered by this means should prove of very great use in the direction not only by guiding farmers in the economical use of pig-feeding materials but also assisting in the breeding and selection of the most desirable strains of pigs for local and overseas markets."